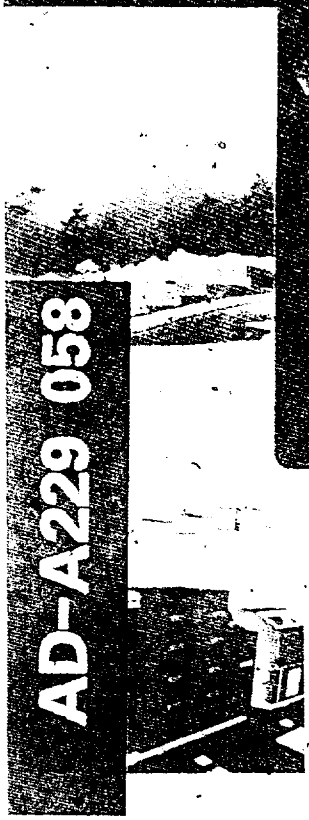
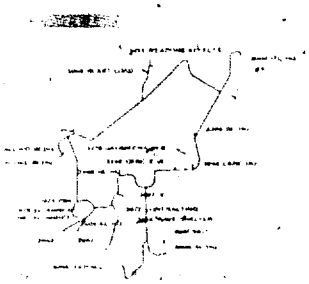


CKBONE CONFIGURATION



TECHNICAL REPORT ITL-90-5

2

WES FIBER OPTICS ETHERNET COMMUNICATION SYSTEM

by

Michael G. Ellis

Information Technology Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199

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The development of an advanced plan for office automation, the proposed implementation of an onsite supercomputer, and the imminent plans for a corporate data base will overburden the existing communications network at the US Army Engineer Waterways Experiment Station (WES). These events have accelerated the requirements for WES to upgrade its current communications network to handle the needs of the next 25 years.

Plans have been formulated to integrate the data requirements of the entire WES site by constructing a high-speed fiber optic backbone network to handle any type of communication requirements. The ultimate objective is to allow any user to transparently communicate with any other device on the network. Keywords; Fiber optics, Supercomputers, Communications networks, Army Corps of Engineers. (RH)

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US Army Engineer Waterways Experiment Station--Communication systems
Telecommunication systems
Computer networks--Mississippi--Vicksburg
Optical communications

PREFACE

This report details the technical aspects of a high-speed fiber optic backbone ethernet to handle the communication requirements of the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi.

This report was written by Michael G. Ellis, Information Technology Laboratory (ITL), WES, under the supervision of Dr. Windell F. Ingram, Chief, Computer Science Division, and Dr. N. Radhakrishnan, Chief, ITL. The study was monitored in ITL by Messrs. Jerry Graham, Pat Spencer, and Ed Woods.

Special credit is due to Mr. Jim Holder of Instrumentation Services Division for his help in obtaining information on the equipment and preparing the drawings for this document.

COL Dwayne G. Lee, EN, Commander and Director of WES, gave the final approval for the implementation of the network. Dr. Robert W. Whalin was the Technical Director and provided support for many aspects of the project.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
feet	0.3048	metres
inches	25.4	millimetres
miles (US statute)	1.609344	kilometres

WES FIBER OPTICS ETHERNET COMMUNICATION SYSTEM

PART I: INTRODUCTION

1. The development of an advanced plan for office automation, the proposed implementation of an onsite supercomputer, and imminent plans for a corporate data base will all overburden the existing communications network at the US Army Engineer Waterways Experiment Station (WES). These events have accelerated the requirements for WES to upgrade its current communications network to handle the needs of the next 25 years.*

2. Communications at WES have been carried for the previous 50 years by copper wire. This report provides the details for the installation of a multimode fiber optic cabling system to connect many of the larger facilities within WES for low- and high-speed data communications.

3. Other factors that have indicated a need to upgrade the WES communication facilities were the apparent inability to expand the Dimension 2000 premise-based voice system to support additional asynchronous dial-up modem traffic. The current conclusion is that the fiber optic network will offset the need for approximately 200 modems that presently account for 200 lines on the D2000 PBX.

4. The fiber optic communications network is modeled after networks that have been installed in major universities throughout the United States. The "WES Communications Plan for Voice and Data"** is the precursor for this document and outlines the requirements for the future WES communications network.

5. This document describes the fiber optic cabling and the ethernet equipment to interface to the fiber optic backbone. The electronic interface equipment comprises the "gateways" to the fiber optic backbone, and each of the 22 buildings has one gateway point for access to the fiber. The networks inside each building will be a mix of ethernets including DECnet, transmission

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* An electronic mail directory is available upon request from the author.
** Michael G. Ellis. 1989. "WES Communications Plan for Voice and Data," Technical Report ITL-89-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

control protocol/internet protocol (TCP/IP), Novell, and Xerox network standard (XNS). This report does not attempt to describe the networks inside each building but only the general backbone system up to and including the gateway, since the individual building networks are the responsibility of the various laboratories and staff elements.

Fiber Optic Cable Specifications

6. Specifications for the fiber optic cable call for the equivalent of AT&T 3DAX graded index fiber. This cable is a 62.5/125/0.29-μ multimode fiber that will terminate in ST type connectors in each of 22 locations. The cable was intended to have windows at 850 nanometers (nm) to accommodate ethernet, and at 1,300 nm to accommodate FDDI (fiber distributed data interface). Layout of the fiber is intended to be in an underground conduit system consisting of a 4-in.* polyvinyl chloride pipe with three separate 1-1/4 in. innerducts. The cabling was scheduled for completion during FY89. Partial fiber specifications are given below:

a. Model: 3DAX Lightpack stranded, or equivalent.

b. Loss: 3.65 db/km at 860 nm with a bandwidth of 160 Mhz-km.
1.10 db/km at 1,300 nm with a bandwidth of 450 Mhz-km.

c. Count: All cables are 24 strand multimode.

Station Layout

7. A WES site map is given in Figure 1, and a layout of the fiber is shown in Figure 2. The 22 buildings connected by the fiber are given below, including distances, number of fibers, and building identifications.

From	To	Footage	No. of Fibers
BLDG 1000	BLDG 1073	2152	24
BLDG 1073	BLDG 1078	1312	24
BLDG 1073	BLDG 1007	702	24
BLDG 1073	BLDG 1006	1243	24
BLDG 1006	BLDG 3200	2155	24
BLDG 3200	BLDG 6000	3379	24

(Continued)

* A table of factors for converting non-SI units of measurement to metric (SI) is presented on page 3.

From	To	Footage	No. of Fibers
BLDG 3200	BLDG 3046	2316	24
BLDG 3200	BLDG 3072	1794	24
BLDG 6000	BLDG 6006	2273	24
BLDG 6000	BLDG 6011	613	24
BLDG 3072	BLDG 2053	1817	24
BLDG 3072	BLDG 6006	2293	24
BLDG 3200	BLDG 3288	1837	24
BLDG 3288	BLDG 3296	1003	24
BLDG 3296	BLDG 3278	813	24
BLDG 3296	BLDG 3396	1909	24
BLDG 3396	BLDG 8000	4015	24
BLDG 8000	BLDG 5014	6417	24
BLDG 5014	BLDG 5008	875	24
BLDG 5014	BLDG 1000	5354	24
BLDG 1000	BLDG 1003	472	24
BLDG 3200	BLDG 3067	948	24
BLDG 2053	BLDG 2025	98	24

Total Footage = 45,790 ft, or 8.67 miles

Building Identification

1000 Vogel Building
1003 Visual Production Center (VPC) Building
1006 EL Headquarters
1007 Environmental Laboratory (EL) Annex
1073 Current PBX
1078 EL Annex
2025 Post Exchange
2053 Conference Room (Information Technology Laboratory (ITL))
3046 Wave Shelter No. 1 Coastal Engineering Research Center (CERC)
3067 Hydraulics Analysis Division (Hydraulics Laboratory (HL))
3072 Contracting Division
3278 Geomechanics Division, Structures Laboratory (SL)
3288 Computation & Analysis, Geotechnical Laboratory (GL)
3396 Casagrande Building
5008 Blast Load Generator (SL)
5014 Weapons Effects Building (SL)
6000 SL Headquarters
6006 J.V. Hall Building (CERC)
6011 Ecosystem Research and Simulation Division (EL)

8. Figure 3 shows an overlay of the fiber route on an aerial photograph of WES.

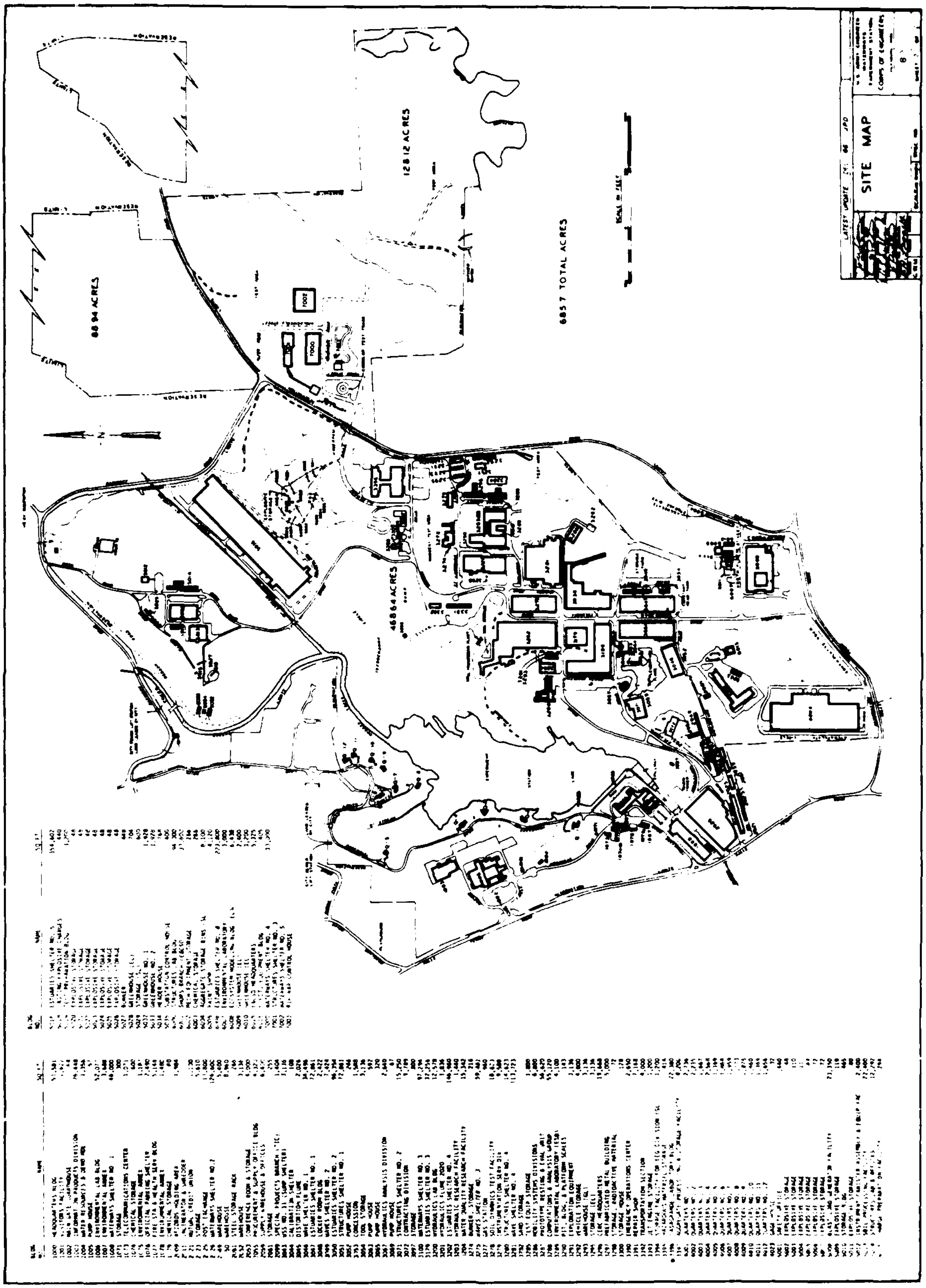


Figure 1. Site map

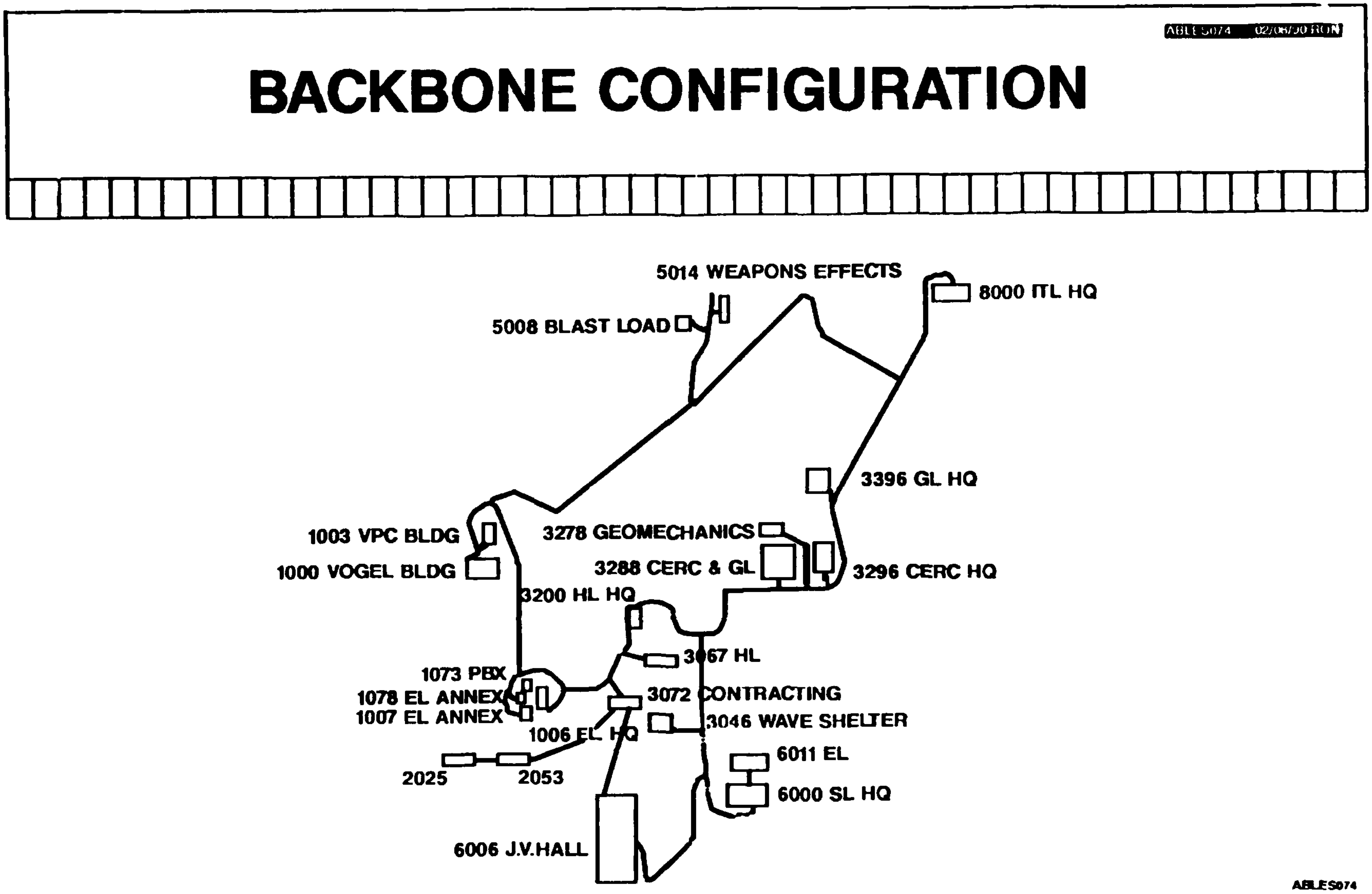


Figure 2. Fiber layout

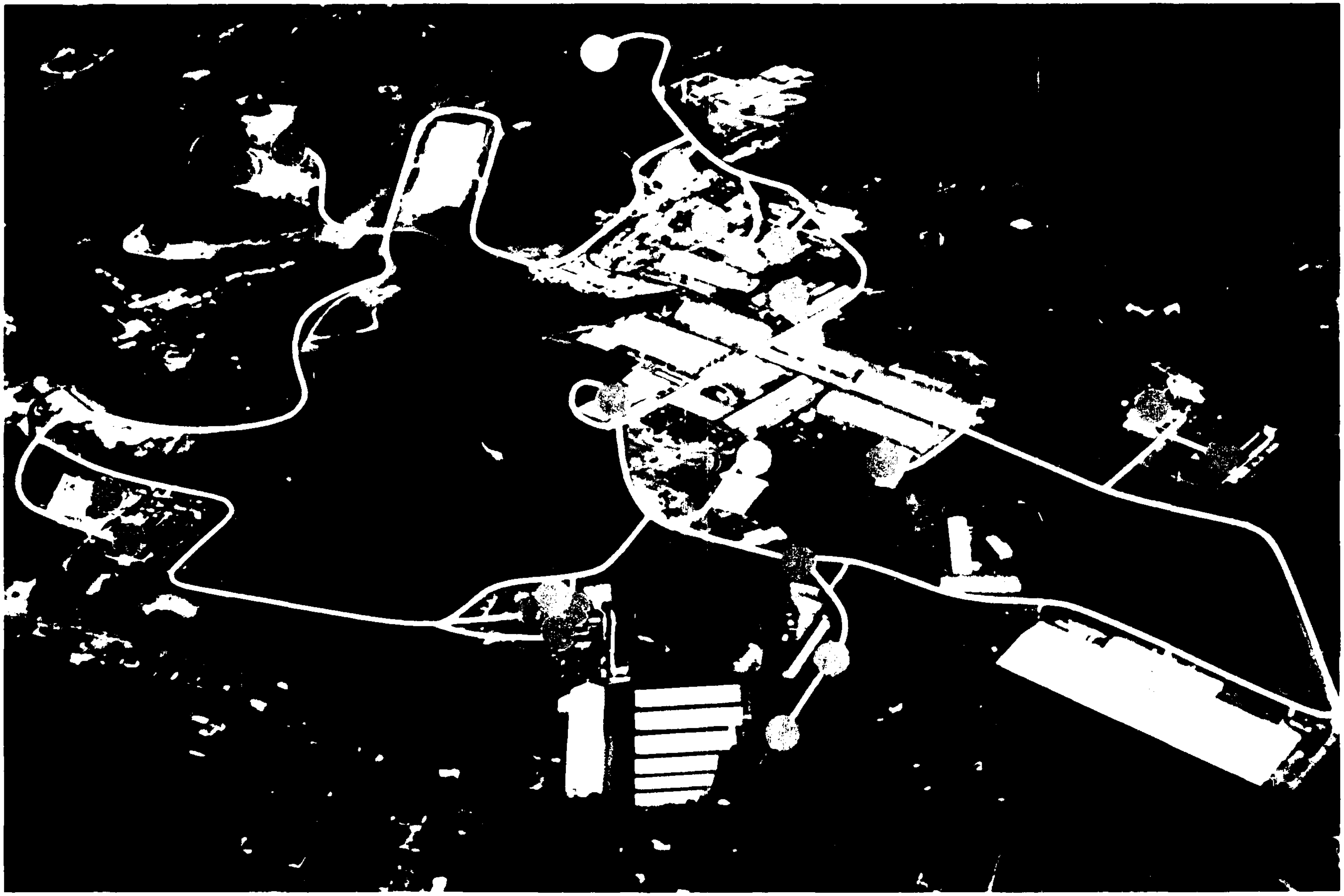


Figure 3. Fiber route

PART II: FIBER OPTIC GATEWAYS, A DETAILED DESCRIPTION BY LOCATION

9. This part provides a detailed description at each of the 22 locations and the hardware configuration of each gateway. A gateway consists of the fiber terminating in ST connections, fiber optic patch cables, fiber optic star couplers, fiber optic transceivers, DEC Lanbridge 100's, Retix ethernet bridges, miscellaneous components and parts, and a 19-in. rack with lockable door to contain the equipment. A site preparation letter requested that each WES laboratory make provisions for space to accommodate two 19-in. racks, with swingable front and back door, and one power outlet within 10 ft of the rack. Only one rack will be needed initially in most locations, but space should be provided for future expansions.

Breaking the Loop With Ethernet Bridges

10. A single ethernet network functions at a maximum distance of 2,000 m. Because of this, the WES station ethernet must be bridged at least every 2,000 m to maintain the integrity of ethernet. Hence the ethernet "ring" is broken every 1,000 to 2,000 m with a DEC Lanbridge 100 in order to buffer and repeat the signal. The maximum number of bridges for an ethernet packet is seven, and the WES ethernet is designed so that most traffic flows through less than seven bridges.

Isolating Buildings With Ethernet Bridges

11. Retix bridges are used to isolate many of the individual buildings from the fiber optic ethernet backbone. While DEC bridges were used to segment the backbone "ring," Retix was chosen to bridge the entrance into the buildings since the Retix bridge is inexpensive. Both the Retix and the DEC bridges have software management control that allows user statistics to be gathered. Parts of the network can be shut off, from Building 8000, for network troubleshooting.

12. The backbone "ring" is not really a ring at all. It is a distributed bus with a redundant path for traffic flow. If there is a break in the main path of the fiber, then the DEC Lanbridge will automatically sense the beak, switch over to use the redundant path, and alert ITL control of the malfunction. Users should not notice any degradation, and the fiber can be

spliced at a normal pace. This feature is made possible by the use of a spanning tree algorithm in the DEC Lanbridge. The Retix bridge does not use a spanning tree algorithm, and should be used only for isolating traffic at the entrance of a building.

Gateway Detail Overview

13. Figure 4 shows the wiring overview for the 22 node locations. Each individual location is shown in full detail in Figures 5-26. Appendix A gives the results of the fiber optic cable tests.

14. The Institute of Electrical and Electronic Engineers (IEEE) 802.3 specifications say that a maximum of two repeaters can be used before a bridge. In the WES implementation, the Chipcom Ornet Stars are synchronous and therefore do not count as a repeater. DELNIs are not counted as repeaters, but DEMPRs (thin wire multiport repeaters) and DEREPs (ethernet repeaters) are to be counted.

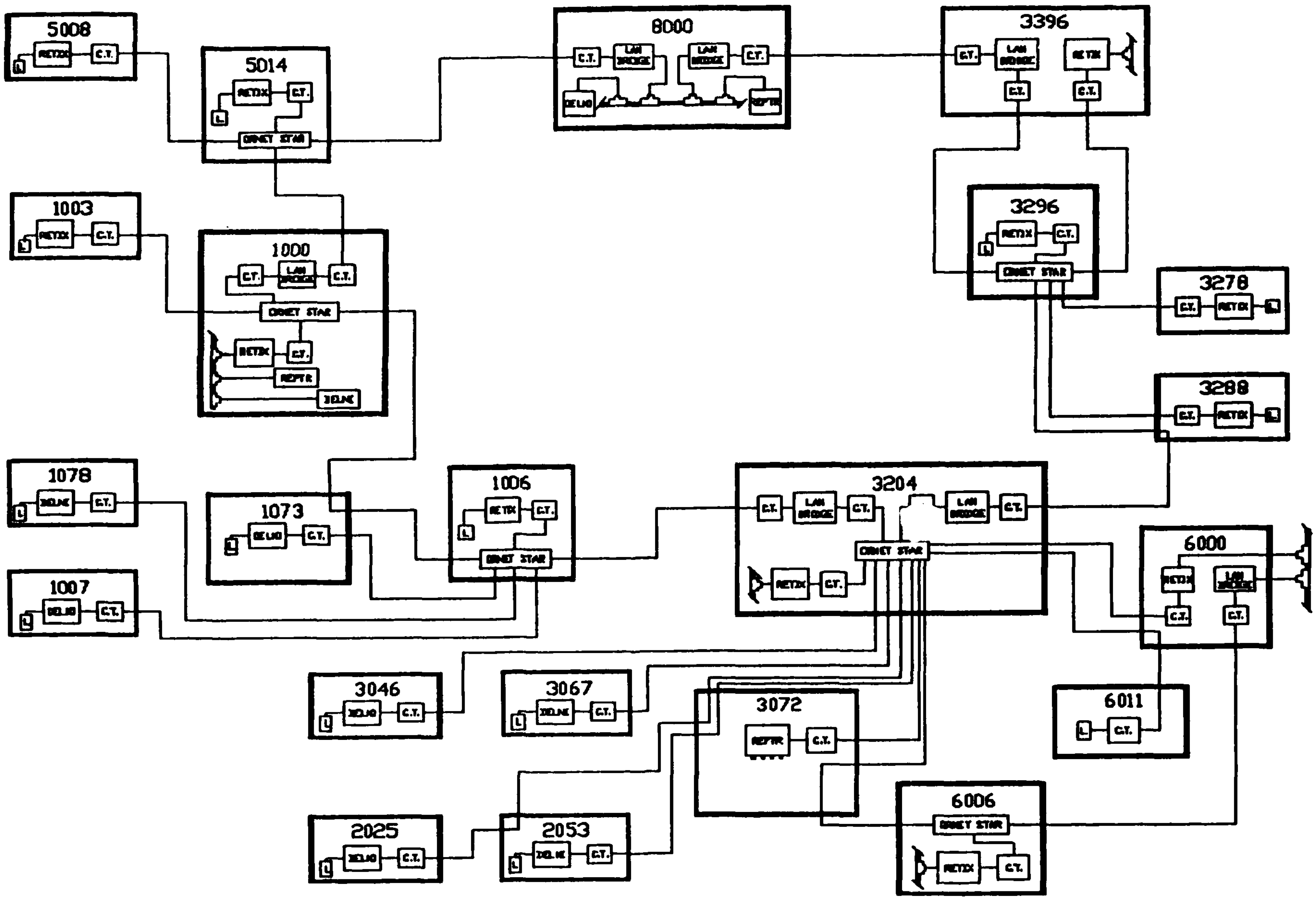
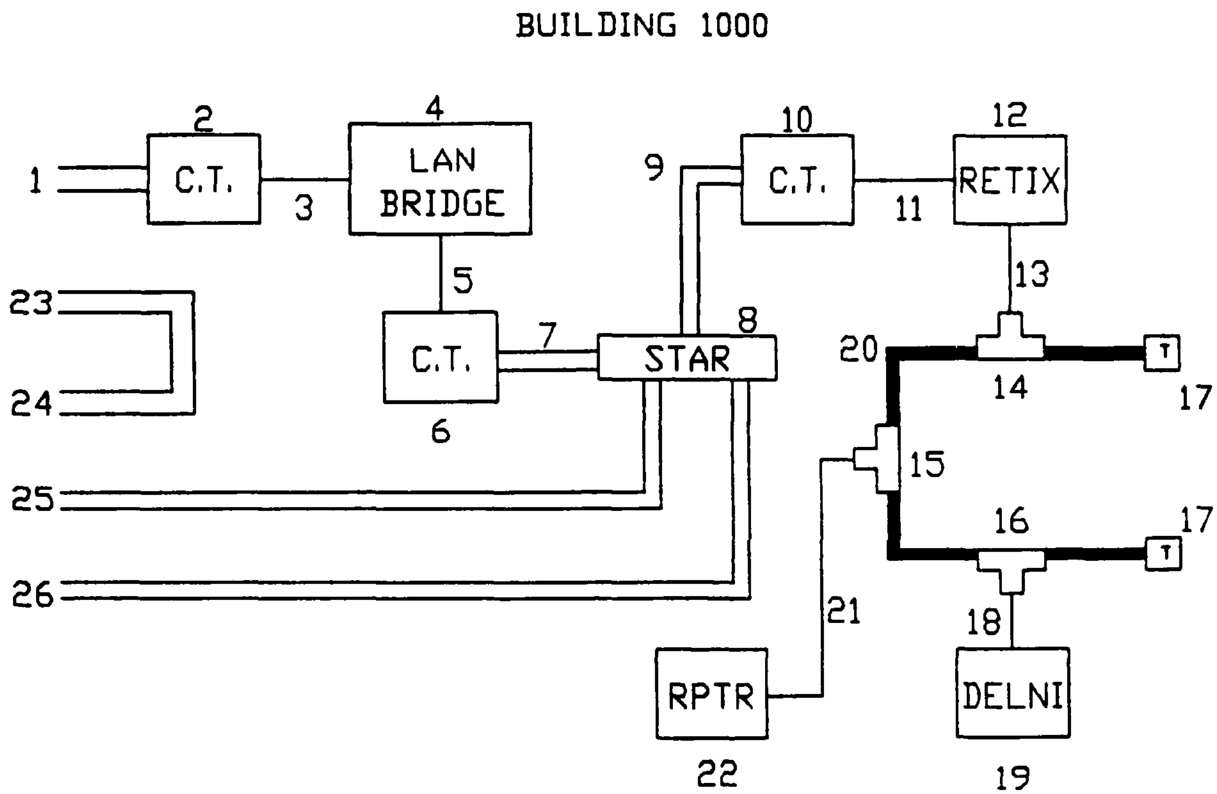


Figure 4. Fiber optic gateway detail overview

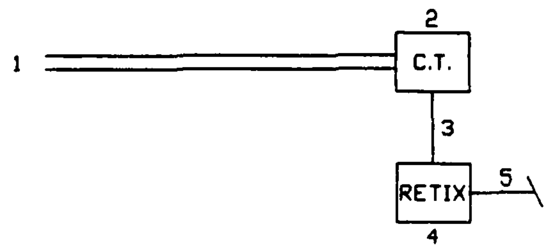


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 5014, FIBER PANEL E1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01731, B/C-D1419
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. DEC LANBRIDGE-100, S/N-AS91518508, B/C-D1064
   ADDRESS: NAME-B1
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01726, B/C-D1421
7. FIBER PAIR TO STAR PORT #4
8. CHIPCOM ORNET STAR, MODEL 9314S, S/N-00530, B/C-NONE
   CHIPCOM BACKUP POWER SUPPLY, S/N-00276, B/C-1610
9. FIBER PAIR FROM STAR PORT #6
10. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01725, B/C-D1415
11. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
12. RETIX BRIDGE, MODEL 2244, S/N-013744, B/C-D1450
13. TRANSCEIVER CABLE, MONCO 5958
14. TRANSCEIVER, BICC TYPE 1114-1, S/N-TE011957H, B/C-NONE
15. TRANSCEIVER, BICC TYPE 1114-1, S/N-TE013286H, B/C-NONE
16. TRANSCEIVER, CABLETRON ST500-01, S/N-15268906, B/C-D1347
17. TERMINATION, 50 OHM
18. TRANSCEIVER CABLE, MONCO 5958
19. BICC FAN OUT UNIT, MODEL 1130, S/N-MA09289B8, B/C-D1523
20. DEC THICKNET COAXIAL CABLE
21. TRANSCEIVER CABLE, YW22724
22. BICC THINNET REPEATER, MODEL 1125, S/N-HA7583, B/C-C9718
23. FIBER PAIR FROM BUILDING 5014, PANEL E1-3,4
24. FIBER PAIR FROM BUILDING 1073, PANEL I1-3,4
25. FIBER PAIR FROM STAR PORT #2 TO BUILDING 1003, PANEL A1-1,2
26. FIBER PAIR FROM STAR PORT #1 TO BUILDING 1073, PANEL I1-1,2

Figure 5. Building 1000 gateway detail

BUILDING 1003

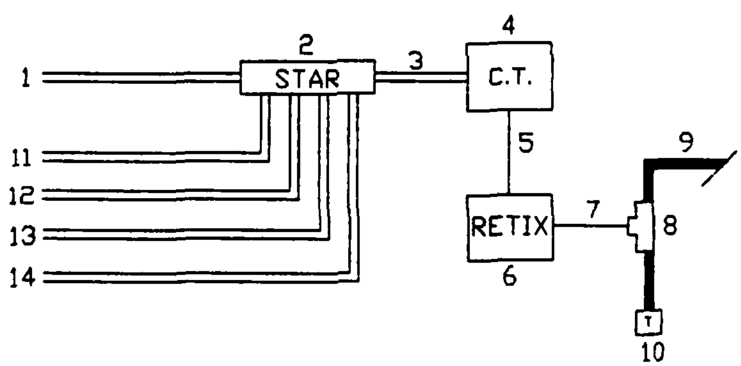


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 1000, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01817, B/C-D1406
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. RETIX BRIDGE, MODEL 2244, S/N-013742, B/C-D1448
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036

Figure 6. Building 1003 gateway detail

BUILDING 1006

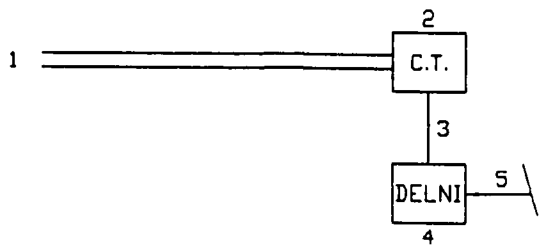


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 1073, FIBER PANEL E1-1,2 TO STAR PORT #2
2. CHIPCOM ORNET STAR, MODEL 9314S, S/N-00432
3. FIBER PAIR FROM STAR PORT #1
4. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01819, B/C-D1403
5. TRANSCEIVER CABLE, XYPLEX 1-350-0036
6. RETIX BRIDGE, MODEL 2244, S/N-013746, B/C-D1451
7. TRANSCEIVER CABLE, XYPLEX 1-350-0036
8. TRANSCEIVER, CABLETRON ST500-01, S/N-15248906, B/C-D1346
9. USER THICKNET COAXIAL CABLE
10. USER TERMINATION, 50 OHM
11. FIBER PAIR FROM STAR PORT #6 TO BUILDING 3204, PANEL A1-3,4
12. FIBER PAIR FROM STAR PORT #5 TO BUILDING 1073, PANEL E1-3,4
13. FIBER PAIR FROM STAR PORT #4 TO BUILDING 1073, PANEL E1-5,6
14. FIBER PAIR FROM STAR PORT #3 TO BUILDING 1073, PANEL F1-1,2

Figure 7. Building 1006 gateway detail

BUILDING 1007

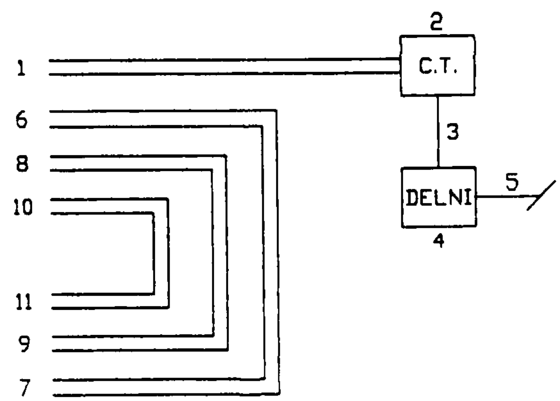


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 1073, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01813, B/C-D1405
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC FAN OUT UNIT, MODEL 1130, S/N-MA09671B8, B/C-D1615
5. TRANSCEIVER CABLE, BLACK BOX # LCN200-0033-MF-0000

Figure 8. Building 1007 gateway detail

BUILDING 1073

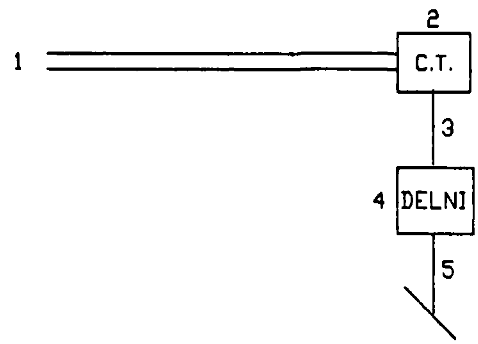


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 1006, FIBER PANEL A1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01729, B/C-D1414
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC FAN OUT UNIT, MODEL 1130, S/N-MA04405B8, B/C-C9723
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. FIBER PAIR FROM BUILDING 1000, PANEL A2-1,2
7. FIBER PAIR TO BUILDING 1006, PANEL A1-3,4
8. FIBER PAIR FROM BUILDING 1007, PANEL E2-1,2
9. FIBER PAIR TO BUILDING 1006, PANEL A1-5,6
10. FIBER PAIR FROM BUILDING 1078, PANEL E1-1,2
11. FIBER PAIR TO BUILDING 1006, PANEL B1-1,2

Figure 9. Building 1073 gateway detail

BUILDING 1078

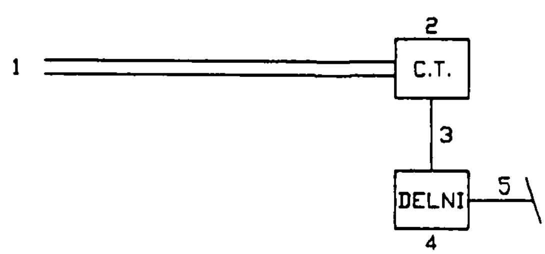


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 1006, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01821, B/C-D1400
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC FAN OUT UNIT, MODEL 1130, S/N-MA0931988, B/C-D1526
5. TRANSCEIVER CABLE, BLACK BOX # LCN200-0033-MF-0000

Figure 10. Building 1078 gateway detail

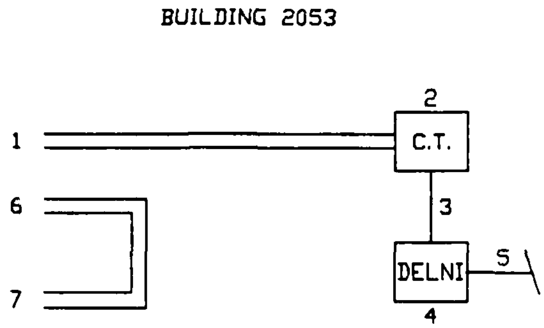
BUILDING 2025



EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 2053, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01715, B/C-D1427
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC FAN OUT UNIT, MODEL 1130, S/N-MA0912988, B/C-D1530
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036

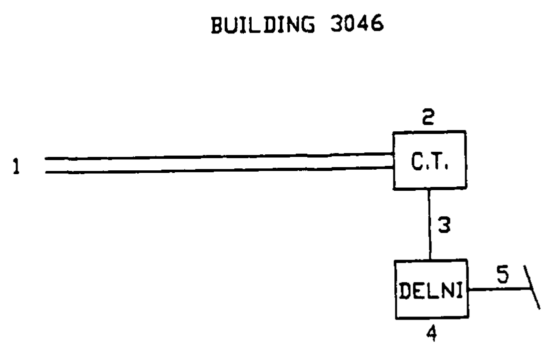
Figure 11. Building 2025 gateway detail



EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3072, FIBER PANEL A1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02577, B/C-D2430
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC FAN OUT UNIT, MODEL 1130, S/N-MA09231B8, B/C-D1527
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. FIBER PAIR FROM BUILDING 3072, PANEL A1-3,4
7. FIBER PAIR TO BUILDING 2025, PANEL E1-1,2

Figure 12. Building 2053 gateway detail

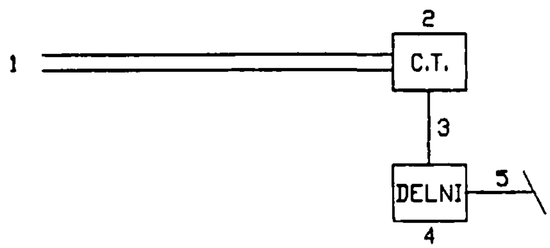


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3204, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02584, B/C-D2428
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC FAN OUT UNIT, MODEL 1130, S/N-MA08709B8, B/C-D1617
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036

Figure 13. Building 3046 gateway detail

BUILDING 3067

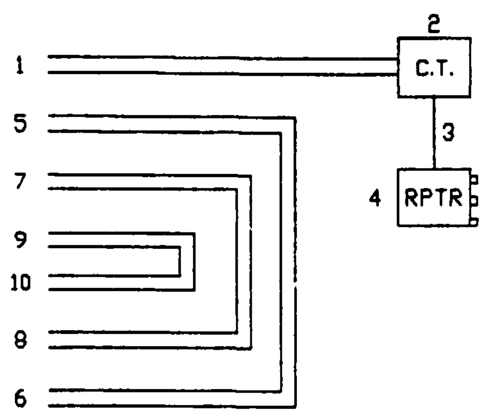


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3204, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01716, B/C-D1425
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC FAN OUT UNIT, MODEL 1130, S/N-MA04255B8, B/C-C9717
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036

Figure 14. Building 3067 gateway detail

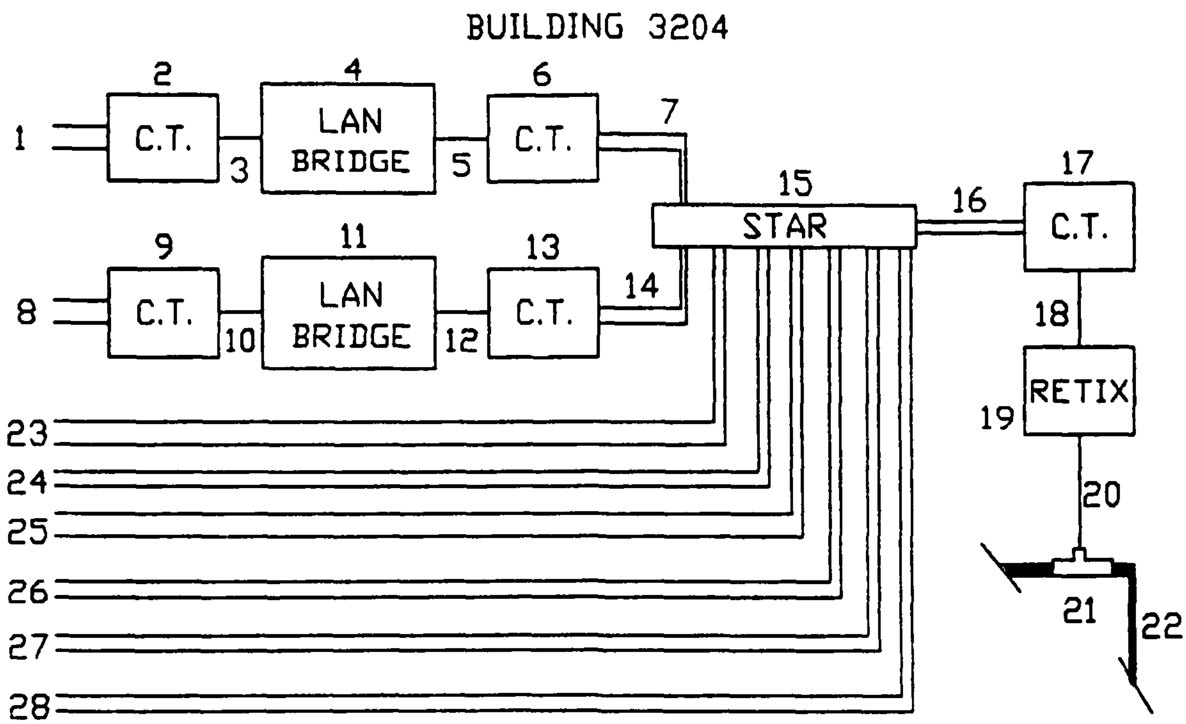
BUILDING 3072



EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3204, FIBER PANEL A1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02583, B/C-D2426
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. BICC THINNET REPEATER, S/N-ME000820H, B/C-E1789
5. FIBER PAIR FROM BUILDING 3204, PANEL A2-1,2
6. FIBER PAIR TO BUILDING 6006, PANEL E1-1,2
7. FIBER PAIR FROM BUILDING 3204, PANEL A1-3,4
8. FIBER PAIR TO BUILDING 2053, PANEL I1-1,2
9. FIBER PAIR FROM BUILDING 3204, PANEL A1-5,6
10. FIBER PAIR TO BUILDING 2053, PANEL I1-3,4

Figure 15. Building 3072 gateway detail

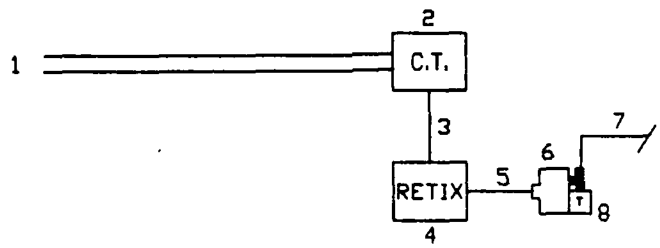


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 1006, FIBER PANEL A1-3,4
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01728, B/C-D1417
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. DEC LANBRIDGE-100, S/N-AS91518511, B/C-D1063
   ADDRESS: NAME-B2
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02574, B/C-D2425
7. FIBER PAIR FROM CT TO STAR PORT #2
8. FIBER PAIR FROM BUILDING 3288, FIBER PANEL I1-1,2
9. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01727, B/C-D1424
10. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
11. DEC LANBRIDGE-100, S/N-AS91518509, B/C-D1062
    ADDRESS: NAME-B3
12. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
13. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02575, B/C-D2431
14. FIBER PAIR FROM CT TO STAR PORT #3
15. CHIPCOM ORNET STAR, MODEL 9314S, S/N-00405, B/C-NONE
16. FIBER PAIR FROM STAR PORT #1
17. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02580, B/C-D2429
18. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
19. RETIX BRIDGE, MODEL 2244, S/N-013747, B/C-1439
20. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
21. TRANSCEIVER, CABLETRON ST500-01, S/N-15288906, B/C-D1349
22. USER LOCAL NETWORK THICKNET CABLE
23. FIBER PAIR FROM STAR PORT #7 TO BUILDING 6000, PANEL B2-1,2
24. FIBER PAIR FROM STAR PORT #6 TO BUILDING 3072, PANEL E2-1,2
25. FIBER PAIR FROM STAR PORT #5 TO BUILDING 3067, PANEL I2-1,2
26. FIBER PAIR FROM STAR PORT #4 TO BUILDING 3046, PANEL E1-1,2
27. FIBER PAIR FROM STAR PORT #8 TO BUILDING 3072 (2025), PANEL E2-3,4
28. FIBER PAIR FROM STAR PORT #9 TO BUILDING 3072 (2053), PANEL E2-5,6

Figure 16. Building 3204 gateway detail

BUILDING 3278

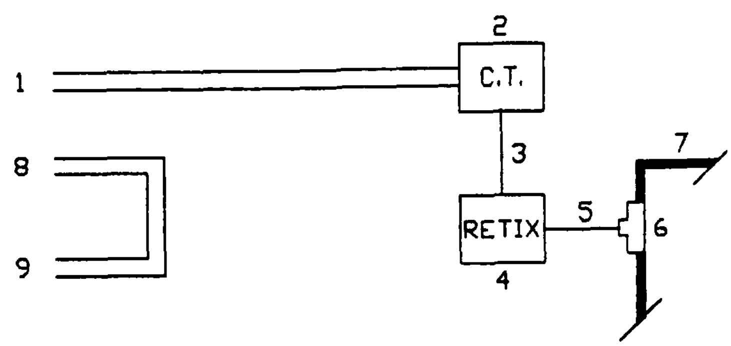


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3204, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01820, B/C-D1402
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. RETIX BRIDGE, MODEL 2244, S/N-01372F, B/C-D1444
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. STATION ADAPTER, DEC DESTA-AA, S/N-AS90487560, B/C-D1083
7. USER THINNET COAXIAL CABLE
8. USER TERMINATION, 50 OHM

Figure 17. Building 3278 gateway detail

BUILDING 3288

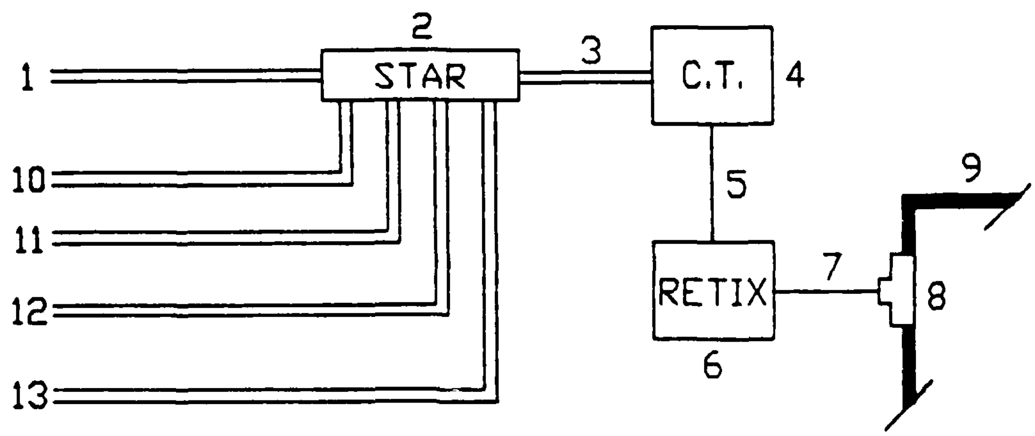


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3296, FIBER PANEL A1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01818, B/C-D1409
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. RETIX BRIDGE, MODEL 2244, S/N-01373D, B/C-D1440
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. TRANSCEIVER, CABLETRON ST500-01, S/N-15278906, B/C-D1345
7. USER THICKNET COAXIAL CABLE
8. FIBER PAIR FROM BUILDING 3296, PANEL A1-3,4
9. FIBER PAIR TO BUILDING 3204, PANEL E1-1,2

Figure 18. Building 3288 gateway detail

BUILDING 3296

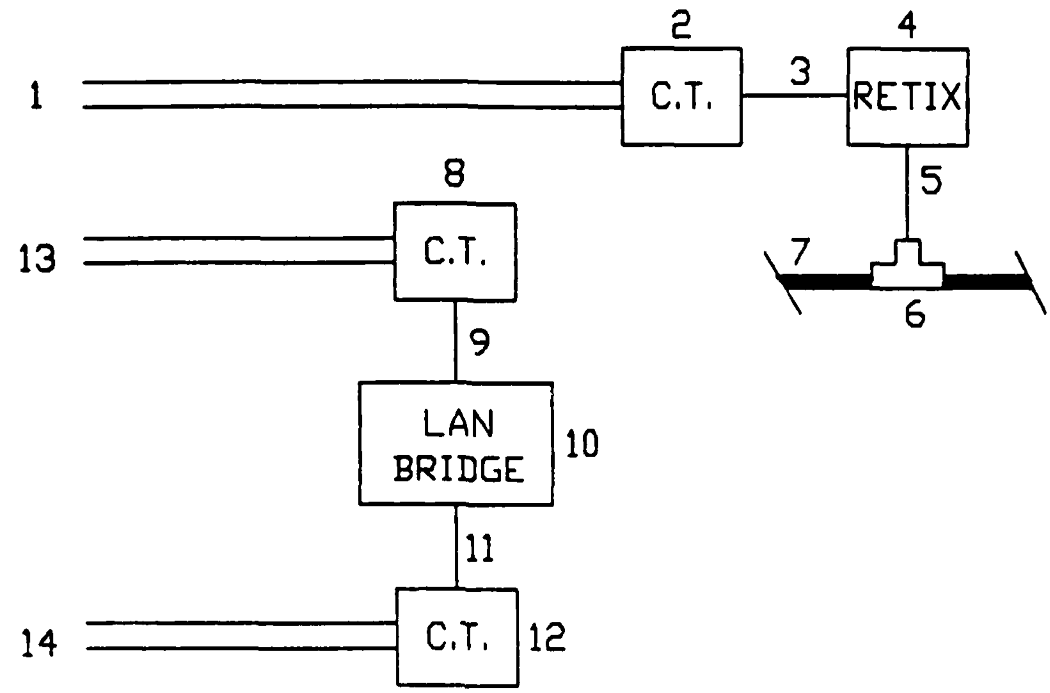


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3288, FIBER PANEL E1-1,2 TO STAR PORT #4.
2. CHIPCOM ORNET STAR, MODEL 9314S, S/N-00431, B/C-NONE
3. FIBER PAIR FROM STAR PORT #1
4. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01816, B/C-D1407
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. RETIX BRIDGE, MODEL 2244, S/N-013743, B/C-D1449
7. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
8. TRANSCEIVER, CABLETRON ST500-01, S/N-15218906, B/C-D1350
9. USER THICKNET COAXIAL CABLE
10. FIBER PAIR FROM STAR PORT #2 TO BUILDING 3396, PANEL A1-1,2
11. FIBER PAIR FROM STAR PORT #3 TO BUILDING 3396, PANEL A1-3,4
12. FIBER PAIR FROM STAR PORT #5 TO BUILDING 3288, PANEL E1-3,4
13. FIBER PAIR FROM STAR PORT #6 TO BUILDING 3278, PANEL I1-1,2

Figure 19. Building 3296 gateway detail

BUILDING 3396

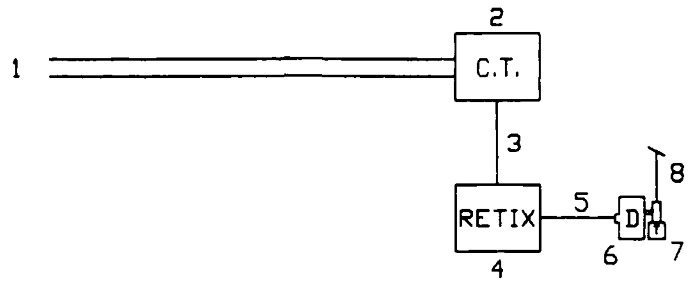


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3296, FIBER PANEL E1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01815, B/C-D1401
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. RETIX BRIDGE, MODEL 2244, S/N-01373F, B/C-D1445
5. TRANSCEIVER CABLE, 5300005
6. TRANSCEIVER, BICC TYPE 1114-1, S/N-TE013277H, B/C-NONE
7. USER THICKNET COAXIAL CABLE
8. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01721, B/C-D1413
9. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
10. DEC LANBRIDGE-100, S/N-AS93520708, B/C-NONE
    ADDRESS: NAME-B4
11. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
12. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02378, B/C-D2427
13. FIBER PAIR FROM BUILDING 8000, PANEL A1-1,2
14. FIBER PAIR FROM BUILDING 3296, PANEL E1-3,4

Figure 20. Building 3396 gateway detail

BUILDING 5008

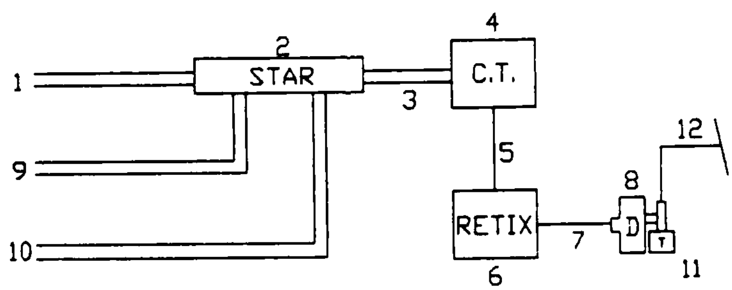


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 5014, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01812, B/C-D1408
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. RETIX BRIDGE, MODEL 2244, S/N-0136FD, B/C-D1446
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. STATION ADAPTER, CABLETRON TMS-3, S/N-9400007-04
7. TERMINATION, 50 OHM
8. USER THINNET COAXIAL CABLE

Figure 21. Building 5008 gateway detail

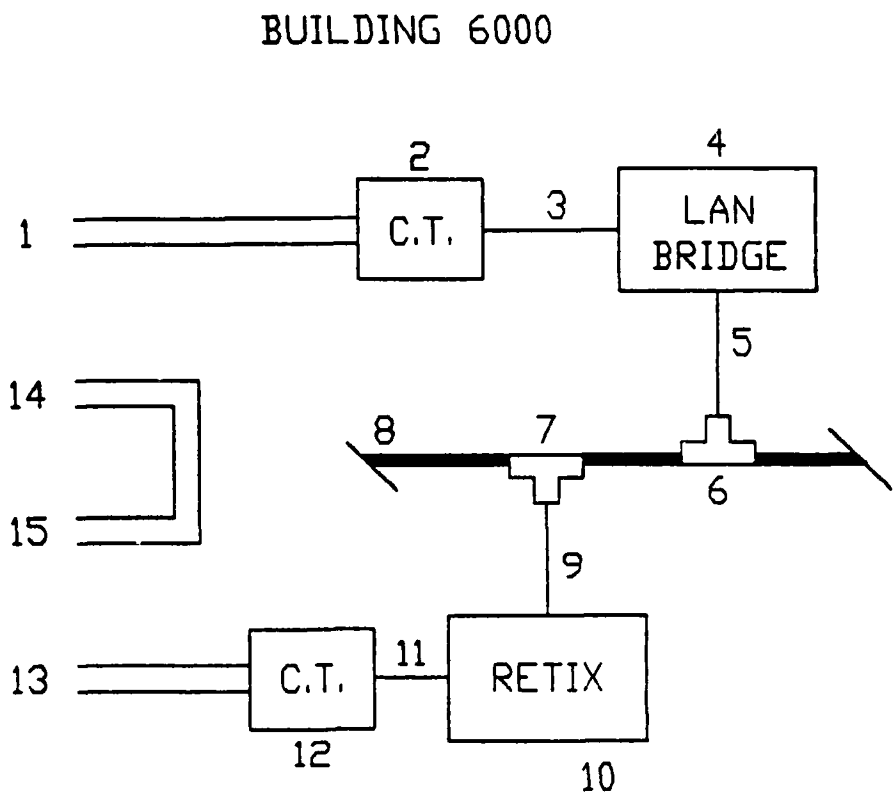
BUILDING 5014



EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 1000, FIBER PANEL E1-1,2 TO STAR PORT #1
2. CHIPCOM ORNET STAR, MODEL 9314S, S/N-17352, B/C-D2423
3. FIBER PAIR FROM STAR PORT #2
4. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01822, B/C-D1410
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. RETIX BRIDGE, MODEL 2244, S/N-013740, B/C-D1438
7. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
8. STATION ADAPTER, DESTA-AA, S/N-AS90487538, B/C-D1086
9. FIBER PAIR FROM STAR PORT #3 TO BUILDING 5008, PANEL E1-1,2
10. FIBER PAIR FROM STAR PORT #4 TO BUILDING 8000, PANEL A1-1,2
11. TERMINATION, 50 OHM
12. USER THINNET COAXIAL CABLE

Figure 22. Building 5014 gateway detail

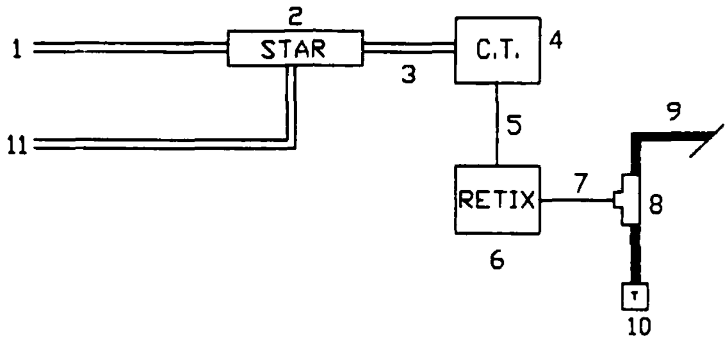


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3204, FIBER PANEL J1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01723, B/C-D1426
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. DEC LANBRIDGE-100, S/N-AS91518513, B/C-D1061
   ADDRESS: NAME-B7
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. TRANSCEIVER, CABLETRON ST500-01, S/N-15208906, B/C-D1348
7. TRANSCEIVER, BICC TYPE 1114-1, S/N-TE014142H, B/C-NONE
8. DEC THICKNET COAXIAL CABLE,
9. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
10. RETIX BRIDGE, MODEL 2244, S/N-013745, B/C-D1442
11. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
12. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01718, B/C-D1422
13. FIBER PAIR TO BUILDING 6006, PANEL A1-1,1
14. FIBER PAIR FROM BUILDING 3204, PANEL J1-3,4
15. FIBER PAIR FROM BUILDING 6011, PANEL E1-1,2

Figure 23. Building 6000 gateway detail

BUILDING 6006

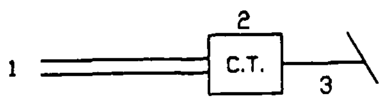


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 3072, FIBER PANEL E1-1,2
2. CHIPCOM ORNET STAR, MODEL 9314S, S/N-00428, B/C-NONE
3. FIBER PAIR FROM STAR PORT #1
4. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-02581, B/C-D2424
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. RETIX BRIDGE, MODEL 2244, S/N-01372D, B/C-D1443
7. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
8. TRANSCEIVER, BICC TYPE 1114-1, S/N-TE013519H, B/C-NONE
9. USER THICKNET COAXIAL CABLE
10. TERMINATION, 50 OHM
11. FIBER PAIR FROM STAR PORT #3 TO BUILDING 6000, PANEL A1-1,2

Figure 24. Building 6006 gateway detail

BUILDING 6011

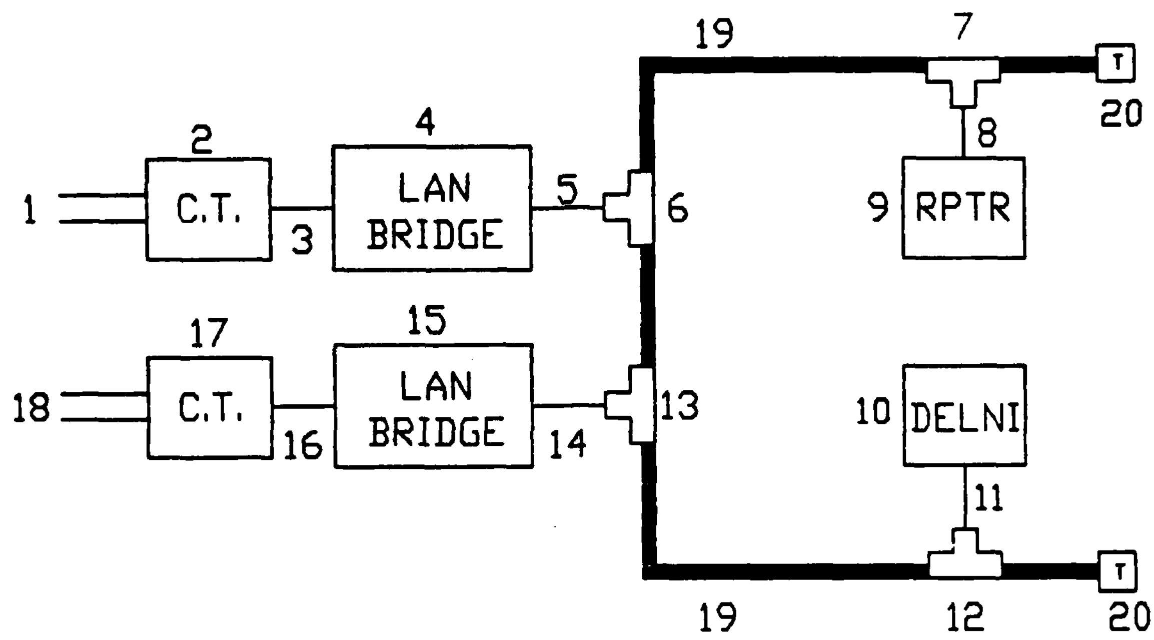


EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 6000, FIBER PANEL 1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01719, B/C-D1418
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036

Figure 25. Building 6011 gateway detail

BUILDING 8000



EQUIPMENT DETAIL

1. FIBER PAIR FROM BUILDING 5014, FIBER PANEL A1-1,2
2. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01724, B/C-D1428
3. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
4. DEC LANBRIDGE-100, S/N-AS91518510, B/C-D1058
   ADDRESS: NAME-B6
5. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
6. TRANSCEIVER, CABLETRON ST500-01, S/N-15258906, B/C-D1344
7. TRANSCEIVER, BICC TYPE 1114-1, S/N-TE011954H, B/C-NONE
8. TRANSCEIVER CABLE, 5300005
9. BICC REPEATER, TYPE 1125, S/N-HA7522, B/C-C9721
10. BICC FAN OUT UNIT, MODEL 1130, S/N-MA04450B8, B/C-C9713
11. TRANSCEIVER CABLE, DEC
12. TRANSCEIVER, BICC TYPE 1114-1, S/N-TE0124534, B/C-NONE
13. TRANSCEIVER, CABLETRON ST500-01, S/N-15228906, B/C-D1351
14. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
15. DEC LANBRIDGE-100, S/N-AS91518514, B/C-D1060
    ADDRESS: NAME-B5
16. TRANSCEIVER CABLE, XYPLEX P/N-1-350-0036
17. CHIPCOM TRANSCEIVER, MODEL 9301T, S/N-01811, B/C-D1404
18. FIBER PAIR TO BUILDING 3396, PANEL E1-1,2
19. DEC THICKNET COAXIAL CABLE
20. TERMINATION, 50 OHM

Figure 26. Building 8000 gateway detail

PART III: NETWORK MANAGEMENT AND CONTROL

Bridging Traffic Between Subnetworks

DEC Lanbridge 100

15. The DEC Lanbridge 100 is used to segment the fiber optic ethernet, and the Retix bridge guards the entrance to each building. Any failure of a network inside a building will be blocked by the Retix bridge and will not cause any problem with the operation of the ethernet on the other side of that bridge. Similarly, any failure in the backbone fiber optic ethernet between buildings will be isolated to that segment of fiber between two DEC Lanbridge 100's.

Remote bridge management software (RBMS)

16. RBMS is an optional product used with the Lanbridge 100's. It significantly enhances the bridge's operation by allowing the network manager, at a VAX or MicroVAX host, to observe and control any Lanbridge 100 in the network. For example, RBMS allows the network manager to put a bridge in backup mode or to block traffic at selected bridges for security reasons.

17. RBMS resides on a VAX or MicroVAX host and works in conjunction with the Lanbridge 100's management firmware. A subset of the IEEE 802.1 management protocol is used to communicate between the VAX host and the targeted bridge. RBMS provides the functions needed to support the actual control and observation of the Lanbridge 100. RBMS features include the following:

a. Has display counters, statistics, characteristics, and forwarding data base.

b. Allows the user to change the operational state, characteristics, and forwarding data base.

c. Enables the user to remotely downline load Lanbridge with Lan Traffic monitor software, changing the device from its default state as a bridge.

d. Uses the IEEE 802.1 management protocol for both DECnet and non-DECnet environments.

e. Allows the user to name and refer to each bridge in ASCII format by mapping ASCII names to physical addresses.

f. Enables the user to use one command to address a group of bridges through the use of global commands.

g. Supports simultaneous access by multiple users on the same or different hosts.

h. Provides extensive on-line help.

i. Allows remote troubleshooting of hardware through the bridge self-test feature.

Table 1 shows a sample status using RBMS to monitor known links.

Logging User Statistics and Troubleshooting

LAN Traffic Monitor (LTM)

18. The LTM is a tool used in multivendor environments to analyze the utilization of an extended local area network (LAN). A Lanbridge 100, downline loaded with the unique monitoring software, is attached to the 802.3 ethernet cable and transmits information to the LTM host software program located on any VAX in the extended LAN. The LTM permits multiple users from anywhere on the extended LAN to access the traffic data.

19. The LTM collects statistics on all LAN traffic regardless of higher level protocol. For example, users of DECnet, TCP/IP, local area transport (LAT), and XNS can study performance on the network by higher level protocol. LTM gives the network manager the flexibility to monitor different segments of an extended LAN and have this information collected at a central location. LTM provides network utilization graphs that show the network manager the performance of the various LAN segments. Features of the LTM include the following:

a. Provides timely, accurate information needed to maximize network performance and plan network growth.

b. Guarantees the integrity of the traffic statistics by capturing every frame and continuously updating the application software.

c. Displays data from multiple monitors on any host running the LTM software in the extended LAN.

d. Gathers traffic statistics from any device connected to the LAN and provides data based on nodes, addresses, and/or protocol types.

e. Provides performance measurements allowing for the optimum configuration and operation of the LAN.

f. Simplifies analysis of LAN traffic data through the use of both graphic and tabular displays.

g. Easy-to-use menu structure shortens the learning curve of the first-time user.

LAN Patrol

20. LAN Patrol is an IBM-compatible software package that allows monitoring of the ethernet. LAN Patrol installs a memory-resident program

Table 1

<u>Sample Status Using RBMS</u>

```
Line characteristics for Line 1  as of   13-JAN-1990 15:55:40
Bridge   B1,   Address
Port id:                      A
State:                        FORWARDING
Line type:                    Ethernet CSMA/CD
Remote management SETs:       Enabled
Collision Presence:           Disabled

Line characteristics for Line 2  as of   13-JAN-1990 15:55:41
Bridge   B1,   Address
Port id:                      B
State:                        BACKUP
Line type:                    Ethernet CSMA/CD
Remote management SETs:       Enabled
Collision Presence:           Disabled

Line characteristics for Line 1  as of   13-JAN-1990 15:55:46
Bridge   B2,   Address
Port id:                      A
State:                        FORWARDING
Line type:                    Ethernet CSMA/CD
Remote management SETs:       Enabled
Collision Presence:           Disabled

Line characteristics for Line 2  as of   13-JAN-1990 15:55:46
Bridge   B2,   Address
Port id:                      B
State:                        FORWARDING
Line type:                    Ethernet CSMA/CD
Remote management SETs:       Enabled
Collision Presence:           Disabled

Line characteristics for Line 1  as of   13-JAN-1990 15:55:51
Bridge   B3,   Address
Port id:                      A
State:                        FORWARDING
Line type:                    Ethernet CSMA/CD
Remote management SETs:       Enabled
Collision Presence:           Disabled

Line characteristics for Line 2  as of   13-JAN-1990 15:55:51
Bridge   B3,   Address
Port id:                      B
State:                        FORWARDING
Line type:                    Ethernet CSMA/CD
Remote management SETs:       Enabled
Collision Presence:           Disabled

Line characteristics for Line 1  as of   13-JAN-1990 15:55:56
Bridge   B4,   Address
Port id:                      A
State:                        FORWARDING
Line type:                    Ethernet CSMA/CD
Remote management SETs:       Enabled
Collision Presence:           Disabled
```

(Continued)

Table 1 (Concluded)

```
Line characteristics for Line 2  as of   13-JAN-1990 15:55:56
Bridge   B4,   Address
Port id:                       B
State:                         FORWARDING
Line type:                     Ethernet CSMA/CD
Remote management SETs:        Enabled
Collision Presence:            Disabled

Line characteristics for Line 1  as of   13-JAN-1990 15:56:01
Bridge   B5,   Address
Port id:                       A
State:                         FORWARDING
Line type:                     Ethernet CSMA/CD
Remote management SETs:        Enabled
Collision Presence:            Disabled

Line characteristics for Line 2  as of   13-JAN-1990 15:56:01
Bridge   B5,   Address
Port id:                       B
State:                         FORWARDING
Line type:                     Ethernet CSMA/CD
Remote management SETs:        Enabled
Collision Presence:            Disabled

Line characteristics for Line 1  as of   13-JAN-1990 15:56:06
Bridge   B6,   Address
Port id:                       A
State:                         FORWARDING
Line type:                     Ethernet CSMA/CD
Remote management SETs:        Enabled
Collision Presence:            Disabled

Line characteristics for Line 2  as of   13-JAN-1990 15:56:08
Bridge   B6,   Address
Port id:                       B
State:                         FORWARDING
Line type:                     Ethernet CSMA/CD
Remote management SETs:        Enabled
Collision Presence:            Disabled

Line characteristics for Line 1  as of   13-JAN-1990 15:56:13
Bridge   B7,   Address
Port id:                       A
State:                         FORWARDING
Line type:                     Ethernet CSMA/CD
Remote management SETs:        Enabled
Collision Presence:            Disabled

Line characteristics for Line 2  as of   13-JAN-1990 15:56:13
Bridge   B7,   Address
Port id:                       B
State:                         FORWARDING
Line type:                     Ethernet CSMA/CD
Remote management SETs:        Enabled
Collision Presence:            Disabled
```

(called the driver) in the network manager's personal computer (PC) that will use only 15 Kb of RAM if the LAN has less than 100 nodes. The amount of RAM used by the driver grows as the number of nodes in the network increases. If the size of the network reaches 1024 nodes, LAN Patrol's maximum, the driver will be using approximately 60 Kb of RAM.

21. Lan Patrol does not require a dedicated PC. The driver works in the background collecting all necessary information. LAN Patrol does not require any software to be running on any other PC on the network at any time. When a PC is running LAN Patrol's driver in the background, it can function normally as a workstation on the network running any software it did before using LAN Patrol.

22. LAN Patrol focuses on the lowest levels of the networking protocol stack, recording which nodes are accessing the network and for how long. This network access information provides the best measure of LAN utilization and tells the real story of what each node is doing and how the entire LAN is performing.

23. The standards that define ethernet specify that the transmission of data at the lowest levels of the networking protocol stack occurs by breaking up data being moved across the network into clearly defined packets. The definition of the structure of these packets remains constant for all ethernet networks. LAN Patrol gathers the following information about the network: the sender of each packet, the receiver of each packet, the size of each packet, and the time the packet was sent.

Excelan LANalyzer

24. The LANalyzer EX 5000 is a powerful, PC-based system designed for managing, monitoring, debugging, and characterizing LAN's. It can be used on networks based on the ethernet specifications as well as on those based on the IEEE 802.3 standard. Its functions include the following:

a. Network performance measurement.

b. Traffic analysis.

c. Network troubleshooting.

d. Network protocol and application debugging.

25. Specific applications of the LANalyzer EX 5000 include:

a. Monitors network traffic, i.e., examines all packets transmitted on the network.

b. Captures, timestamps, and stores packets or packet segments based on user-defined criteria, including packet length, packet content, errors, and time.

c. Decodes protocols, both TCP/IP and DECnet.

d. Computes, displays, and stores statistics about network activity, such as network utilization, network traffic rate, packet capture rate, packet sizes, errors, and interpacket arrival time intervals.

e. Generates network traffic by transmitting user-defined packets. The transmission rate and other transmission conditions are also under user control.

f. Checks cable for connectivity using a time domain reflectometer type function that allows users to test the ethernet cable for discontinuities and to verify the LANalyzer transceiver connections.

26. All LANalyzer system functions are realized by setting up and running a test. A test is essentially a program in which the user specifies the criteria for capturing packets from the network and/or transmitting packets to the network. While a test is running, the status of the network is continually displayed as tables and graphs. In addition, results, which are constantly updated, are shown as the test progresses. The packets or packet segments captured during a test can be saved in a temporary buffer or to a disk file. After a test concludes, the contents of captured packets can be displayed in standard and/or user-defined protocols, or in hexadecimal and ASCII formats; test statistics can be viewed as tables and graphs.

PART IV: ACCESS TO AND LIMITATIONS OF THE WES FIBER OPTIC ETHERNET

Access

27. Access is provided to the WES fiber optic ethernet in the following ways:

- a. In-dial modems (634-4460).
- b. PC's using Novell.
- c. PC's using DECnet-DOS or PCSA.
- d. PC's using TCP/IP.
- e. PC's connected via terminal servers.

Instructions are provided in Appendix B on the use of each of these networks. Appendix C provides instructions for the use of the WES VAX 8800 and the WES CRAY Y-MP 8/6128 supercomputer.

In-dial modems

28. WES maintains a bank of 2400-baud V.22 bis standard modems in a rotary. These modems can provide callers access to any VAX or UNIX resource within WES, given the proper user account and userid. A listing of current DEC services is given in Table 2.

29. In-dial (and out-dial) modems are currently limited to 2400/1200/300 speed access. Consideration has been given to the 9600-baud V.32 standard, and the upgrade of existing modems appears to be imminent. In-dial modems are connected to Emulex terminal servers running the DEC LAT protocol only. Connection to UNIX hosts can be made through several VAX computers onsite that have current DECnet and TCP/IP functions. These VAX computers are frequently used as gateway machines to connect the DEC and UNIX (TCP/IP) networks within WES.

PC's using Novell

30. Currently Novell users are locked out of the VAX and TCP/IP environments. WES is investigating the installation of NOVELL VMS on a VAX in order to provide a gateway to link the Novell and the DEC network. Additionally, WES is studying TCP/IP interfaces for the Novell file servers to provide Novell users with direct access to UNIX hosts, including the CDC CEAP computer and the WES Cray.

31. The Novell network is a very flexible and user-friendly system. The user requires only an ethernet card in his PC since the PC software is free.

Table 2

Current DEC Services

Service Name	Sessions	Identification
AEOLUS	0	SYS$ANNOUNCE
BEACH	0	RESEARCH DIVISION VAX-STATION 2000 BEA
CDC	0	
COAFS1	0	**** C E R C O F F I C E A U T O M A
COAST	0	SYS$ANNOUNCE
CSE	0	@SYS$MANAGER:WELCOME.TXT
CSE1	0	@SYS$MANAGER:WELCOME.TXT
CSE2	0	@SYS$MANAGER:WELCOME.TXT
DIAL	0	
DIGITIZER	0	
DWGDEV	0	PMAB - DWG DEVELOPMENT SYSTEM
ELMSG	0	EL MSG
EVEN12	0	Dial IN/OUT-1200:7E1
EVEN24	0	Dial IN/OUT-2400:7E1
GL0	0	GL0 - VAX 3300
GL1	0	GL1 - VAX 11/785
GL1TS1	0	M1
HAR	0	
HE1	0	Microvax II
HE2	0	Vax Station 3500
HE3	0	VAXstation 3100 - HE3
HL1	0	VAX-11/750 - HL1
HL2	0	MicroVAX 3500 - HL2
HP	0	
HPLASER	0	
HS1	0	VAXstation 3100 - HS1
HWDPS8	0	Honeywell DPS-8
LA100	0	PMAB LA100 printer
LAKE	0	RESEARCH DIVISION VAX-STATION 2000 LAK
M1	0	
M12	0	
MATH	0	none available
METEOR	0	PMAB - NODE METEOR
MMAC8	0	HL MMAC_8
MODEM	0	
MODEM12	0	Dial IN/OUT-1200:8N1
MODEM24	0	Dial IN/OUT-2400:8N1
MSG	0	MICROVAX 3400
NORM1	0	RESEARCH DIVISION VAX-STATION 2000 NOR
OCEAN	0	SYS$ANNOUNCE
ONTIME	0	
ONTYME	0	
OUT7E	0	
OUT8N	0	
PLOTTER	0	
PMAB	0	PMAB - PROTOTYPE MEASURMENT AND ANALYSI
PRINTER	0	
RJE	0	C E R C H A S P A C A T O R S Y S T
SURF	0	SURF ZONE FIELD MEASUREMENT SYSTEM
WAVES	0	SYS$ANNOUNCE
WDD	0	Wave Dynamics Division
WESCR1	0	SYS$ANNOUNCE
WESIM1	0	WESnet Control System
WESIM3	0	ITL VAX 8800

PC's using DECnet-DOS or PCSA

32. PCSA and DECnet-DOS are both DEC communication products. Since DECnet is a subset of PCSA, the following discussion applies equally to both.

33. DECnet allows for PC to host communication using the MS-DOS SETHOST command. Its advantages include easy file transfer capabilities and an electronic mail system for DECnet PC connected to a DECnet host computer. If the host is not a DECnet host, then file transfers are limited to ASCII transfer initiated with the SHIFT-F1 and the CTRL-F1 keys, and there is no electronic mail system.

34. All DEC services currently accessible within WES are shown in Table 2.

PC's using TCP/IP

35. TCP/IP is the current Department of Defense communication standard and can be purchased from many vendors. A public domain version became available recently with significant enhancements over many of the commercial packages.

36. The most common TCP/IP commands are the TELNET command which is used to log on to a TCP/IP or UNIX host, and the FTP command for file transfers to a TCP/IP or UNIX host.

37. WES has a TCP/IP address assigned by the National Internet Committee of 134.164.x.x. In theory, this class B address allows for the assignment of up to 64,000 hosts. WES has settled on a TCP/IP submask of 255.255.252.0 and all PC's and hosts within the WES network must run with this submask. The network portion of the address is defined by 255.255.252, leaving up to 1024 hosts (in practice) that can be assigned inside the WES network. By using this structure, host assignments for WES will fall within the range of 134.164.4.1 to 134.164.7.254.

PC's connected via terminal servers

38. WES terminal servers generally run only the DEC LAT protocol, with eventual upgrade to LAT and TCP/IP. The services available for terminal server users are shown in Table 2 and exclude Novell services and TCP/IP services unless the user accesses a gateway host that has multiple protocols running simultaneously.

Limitations in the WES Ethernet

39. Current limitations of the ethernet that are under study include the following:

a. The inablility to simulate XMODEM file transfers of the high-speed ethernet. This affects both CETAL and ONTYME connections.

b. The inability to access multiple protocols in a PC without having to reboot.

c. The limitations on gateway machines to interconnect Novell, DECnet, and TCP/IP users.

Resolutions of these restrictions are in progress.

PART V: SUMMARY

40. The WES fiber optic network is currently installed to support ethernet traffic. Higher level protocols within ethernet are supported including DECnet, LAT, CTERM, TCP/IP, XNS, and IPX. The Retix bridges and the Lanbridge 100 are protocol-independent devices.

41. In the future, additional fiber strands may be used for WES token ring networks, FDDI (fiber distributed data interface), secure networks, and T1. The fiber optic conduit contains three innerducts. In most locations two of these innerducts are empty and can be used for pulling future cabling as requirements changes.

42. A 300 pair copper line was installed between the PBX in Building 1073 and Building 8000 to provide telephone service to the new ITL building. Even through additional fiber optic cable would have been less expensive than the cost of the 300 pair copper line, the fiber would have required expensive electronic equipment at each end to support the analog phone system. In the final analysis, use of the 300 pair copper line provided the most cost-effective approach to telecommunications to the new ITL building.

43. In addition to higher speed data communications over the fiber, WES is investigating the transmission of video over fiber, access to secure facilities through encryption over the fiber, and migrating to OSI (open systems interconnect) as a protocol that will link all computers in the future.

APPENDIX A: FIBER OPTIC CABLE TEST RESULTS

Table A1

Test Results, Building 1000 to Building 1003*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	0.6	2.4	
2	0.8		
3	0.7		
4	0.9		
5	0.8		
6	0.8		
7	0.9		
8	0.3		
9	0.8		
10	0.7		
11	0.4		
12	0.4		
13	0.3		
14	0.4		
15	0.8		
16	0.9		
17	0.7		
18	0.4		
19	0.3		
20	0.6		
21	0.6		
22	0.6		
23	0.5		
24	0.9		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 144 meters.

Table A2

Test Results, Building 1073 to Building 1000*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		4.0	Jumper
2			Jumper
3	0.5		
4	0.5		
5	0.4		
6	0.4		
7			
8	0.4		
9	0.1		
10	0.5		
11	0.8		
12	0.5		
13	0.4		
14	0.1		
15	0.5		
16	0.5		
17	0.4		
18	0.5		
19	0.8		
20	0.3		
21	0.6		
22	0.3		
23	0.5		
24	0.8		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 656 meters.

Table A3

Test Results, Building 3046 to Building 3200*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.4	4.1	
2	1.1		
3	1.1		
4	1.0		
5	0.8		
6	1.2		
7	1.1		
8	0.9		
9	0.8		
10	0.6		
11	0.7		
12	0.8		
13	1.0		
14	0.7		
15	0.8		
16	0.4		
17	1.0		
18	0.9		
19	0.9		
20	0.8		
21	0.7		
22	0.7		
23	0.7		
24	0.7		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 706 meters.

Table A4

Test Results, Building 3288 to Building 3200*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.5	3.7	
2	2.1		
3	1.7		
4	2.3		
5	1.9		
6	1.8		
7	2.0		
8	1.9		
9	1.8		
10	1.9		
11	2.3		
12	1.8		
13	1.9		
14	2.1		
15	1.6		
16	2.0		
17	1.6		
18	1.7		
19	2.0		
20	1.8		
21	1.5		
22	2.0		
23	2.2		
24	1.8		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 560 meters.

Table A5

Test Results, Building 3072 to Building 3200*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.7	3.6	
2	1.7		
3	1.8		
4	3.3		
5	1.5		
6	1.5		
7	2.0		
8	1.6		
9	2.0		
10	1.5		
11	1.8		
12	1.6		
13	1.9		
14	2.2		
15	1.7		
16	1.7		
17	2.1		
18	1.7		
19	1.6		
20	1.8		
21	1.8		
22	1.5		
23	1.7		
24	1.9		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 547 meters.

Table A6

Test Results, Building 3200 to Building 3067*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.3	2.9	
2	1.2		
3	1.1		
4	1.3		
5	1.6		
6	1.0		
7	1.5		
8	1.9		
9	1.0		
10	1.4		
11	1.5		
12	1.4		
13	1.4		
14	1.1		
15	1.2		
16	1.2		
17	1.1		
18	1.5		
19	1.0		
20	1.3		
21	1.5		
22	1.8		
23	1.5		
24	1.2		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 300 meters.

Table A7

Test Results, Building 1006 to Building 3200*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	2.3	4.0	
2	2.3		
3	2.3		
4	2.5		
5	2.1		
6	2.0		
7	2.1		
8	2.0		
9	2.4		
10	1.9		
11	2.0		
12	2.1		
13	2.8		
14	2.1		
15	2.0		
16	2.5		
17	2.5		
18	1.8		
19	2.3		
20	2.2		
21	2.1		
22	2.0		
23	2.5		
24	2.0		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 657 meters.

Table A8

Test Results, Building 1078 to Building 1073*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.3	2.4	
2	1.1		
3	1.4		
4	1.3		
5	1.3		
6	1.1		
7	1.1		
8	1.7		
9	1.0		
10	1.0		
11	1.3		
12	1.3		
13			Jumper
14			Jumper
15	2.0		
16	1.1		
17	1.2		
18	1.2		
19	1.3		
20	1.3		
21	1.2		
22	1.1		
23	1.8		
24	1.4		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 400 meters.

Table A9

Test Results, Building 1007 to Building 1073*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		2.6	Jumper
2			Jumper
3	1.6		
4	1.4		
5	1.6		
6	1.1		
7	1.6		
8	1.5		
9	1.3		
10	1.1		
11	1.5		
12	1.5		
13	1.5		
14	1.4		
15	2.4		
16	1.2		
17	1.4		
18	1.4		
19	1.6		
20	1.6		
21	2.1		
22	1.4		
23	1.4		
24	1.5		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 214 meters.

Table A10

Test Results, Building 1073 to Building 1006*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		3.1	Jumper
2			Jumper
3			Jumper
4			Jumper
5			Jumper
6			Jumper
7			Jumper
8			Jumper
9	2.0		
10	2.1		
11	2.2		
12	2.1		
13	1.9		
14	1.8		
15	2.1		
16	2.7		
17	2.0		
18	2.0		
19	1.9		
20	1.9		
21	2.0		
22	2.1		
23	2.5		
24	2.5		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 379 meters.

Table A11

Test Results, Building 6000 to Building 3200*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	3.7	5.1	
2	3.6		
3	3.3		
4	3.4		
5	3.5		
6	3.8		
7			Jumper
8			Jumper
9			Jumper
10			Jumper
11	3.2		
12	3.7		
13	4.0		
14	4.1		
15	3.7		
16	3.1		
17	3.2		
18	3.5		
19	4.0		
20	3.6		
21	4.4		
22	3.7		
23	3.5		
24	4.2		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 1030 meters.

Table A12

Test Results, Building 6000 to Building 6011*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.8	2.6	
2	1.4		
3	1.7		
4	1.9		
5	1.8		
6	2.0		
7	1.2		
8	1.1		
9	1.1		
10	0.8		
11	3.2		Changed connectors three times. High loss seems to be in the fiber
12	1.3		
13	1.3		
14	1.8		
15	1.8		
16	1.5		
17	1.3		
18	1.5		
19	1.1		
20	1.3		
21	1.5		
22	1.4		
23	1.2		
24	1.0		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 187 meters.

Table A13

Test Results, Building 6006 to Building 6000*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		4.0	Jumper
2			Jumper
3	2.8		
4	2.3		
5	2.4		
6	2.2		
7	2.3		
8	2.7		
9	3.0		
10	2.4		
11	2.9		
12	3.1		
13	2.5		
14	2.3		
15	2.5		
16	2.7		
17	2.5		
18	2.9		
19	2.7		
20	2.3		
21	3.2		
22	2.8		
23	2.6		
24	3.3		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 693 meters.

Table A14

Test Results, Building 5014 to Building 5008*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		2.8	Jumper
2			Jumper
3	1.1		
4	1.9		
5	0.5		
6	1.2		
7	0.9		
8	1.2		
9	1.4		
10	0.6		
11	1.0		
12	0.3		
13	0.8		
14	0.4		
15	0.8		
16	1.2		
17	0.7		
18	1.0		
19	0.8		
20	0.3		
21	0.4		
22	0.9		
23	0.9		
24	1.8		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 267 meters.

Table A15

Test Results, Building 2053 to Building 2025*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.8	2.9	
2	1.9		
3	1.3		
4	1.8		
5	2.3		
6	1.5		
7	1.5		
8	1.3		
9	2.5		
10	1.1		
11	1.5		
12	1.3		
13	1.3		
14	1.3		
15	1.5		
16	2.1		
17	1.7		
18	2.9		
19	1.0		
20	0.9		
21	1.2		
22	2.2		
23	1.1		
24	1.0		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 301 meters.

Table A16

Test Results, Building 5014 to Building 8000*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		7.9	Jumper
2			Jumper
3	6.2		
4	7.0		
5	6.9		
6	6.7		
7	6.8		
8	6.4		
9	6.1		
10	6.6		
11	6.6		
12	6.7		
13	6.7		
14	6.6		
15	6.2		
16	6.4		
17	6.4		
18	6.3		
19	6.8		
20	6.4		
21	6.3		
22	6.5		
23	6.5		
24	6.7		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 1956 meters.

Table A17

Test Results, Building 3072 to Building 6006*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	3.2	4.1	
2	2.1		
3	2.5		
4	2.4		
5	3.1		
6	2.5		
7	2.8		
8	2.7		
9	2.9		
10	3.0		
11	2.5		
12	2.8		
13	2.6		
14	2.6		
15	2.9		
16	2.4		
17	2.6		
18	2.5		
19	2.4		
20	2.5		
21	2.6		
22	2.9		
23	2.2		
24	2.4		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 699 meters.

Table A18

Test Results, Building 2053 to Building 3072*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1	1.9	2.9	
2	1.9		
3	1.7		
4	1.5		
5	1.7		
6	1.5		
7	2.2		
8	1.6		
9	2.0		
10	1.3		
11	1.5		
12	1.5		
13	2.0		
14	1.8		
15	1.4		
16	1.1		
17	1.7		
18	1.2		
19	2.1		
20	1.7		
21	1.5		
22	1.5		
23	1.5		
24	1.6		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 310 meters.

Table A19

Test Results, Building 3296 to Building 3278*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		2.7	Jumper
2			Jumper
3	1.0		
4	1.9		
5	1.1		
6	1.1		
7	1.0		
8	1.5		
9	1.4		
10	2.1		
11	1.5		
12	1.0		
13	1.1		
14	0.9		
15	1.6		
16	1.5		
17	1.5		
18	1.0		
19	1.3		
20	1.1		
21	1.0		
22	1.1		
23	1.1		
24	2.0		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 248 meters.

Table A20

Test Results, Building 3296 to Building 3396*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		3.7	Jumper
2			Jumper
3			Jumper
4			Jumper
5	2.6		
6	2.7		
7	3.0		
8	2.1		
9	2.7		
10	2.3		
11	2.5		
12	2.5		
13	2.3		
14	2.2		
15	2.3		
16	2.4		
17	2.4		
18	2.9		
19	2.7		
20	3.3		
21	2.6		
22	2.5		
23	2.6		
24	3.1		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 582 meters.

Table A21

Test Results, Building 3396 to Building 8000*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		5.7	Jumper
2			Jumper
3	4.0		
4	4.3		
5	4.1		
6	3.7		
7	4.1		
8	3.6		
9	3.4		
10	4.2		
11	4.0		
12	3.8		
13	4.1		
14	3.7		
15	3.9		
16	3.6		
17	4.2		
18	3.7		
19	4.0		
20	3.7		
21	3.9		
22	4.3		
23	3.9		
24	3.9		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 1224 meters.

Table A22

Test Results, Building 5014 to Building 1000*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		6.9	Jumper
2			Jumper
3	5.6		
4	5.3		
5	5.7		
6	5.9		
7	5.9		
8	5.4		
9	5.3		
10	5.5		
11	6.4		
12	5.3		
13	6.2		
14	5.1		
15	5.9		
16	5.7		
17	5.4		
18	5.1		
19	4.8		
20	5.5		
21	5.6		
22	5.9		
23	5.1		
24	5.2		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 1632 meters.

Table A23

Test Results, Building 3296 to Building 3288*

Fiber No. or Color	Actual Attenuation	Allowable Attenuation	Comments
1		2.9	Jumper
2			Jumper
3			Jumper
4			Jumper
5	1.3		
6	1.3		
7	1.8		
8	2.4		
9	1.1		
10	1.9		
11	1.6		
12	2.3		
13	1.3		
14	1.1		
15	1.0		
16	1.9		
17	1.3		
18	1.4		
19	1.3		
20	1.6		
21	2.0		
22	1.4		
23	1.8		
24	1.4		

* Cable: 24 fiber, AT&T Light Pak; Measurement technique: power meter; Length of run: 306 meters.

APPENDIX B: INSTRUCTIONS FOR USING THE US ARMY ENGINEER WATERWAYS EXPERIMENT STATION (WES) NETWORK (AS OF 26 FEB 1990)

Network Menu

Each user has a network menu that can be invoked by typing the word NETWORK. The menu will contain some of the following selections, depending on individual configurations:

1 Quit
2 Standard Autoexec and Config
3 Novell Ethernet Network
4 DECnet-DOS Ethernet Network
5 NCSA TCP/IP Ethernet Network
6 Asynchronous Network

1. Quit returns the user to the MS-DOS prompt.

2. Select Standard Autoexec and Config to operate independently of the network. This option restores the PC to its original condition prior to the installation of the network hardware and software.

3. Select Novell Ethernet Network to access any Novell fileservers on the WES fiber optic network.

4. Select DECnet-DOS Ethernet Network to access any of 40 VAX computers within WES, the network modem pool, or the Honeywell DPS-08 computer. DECnet-DOS network addresses are assigned by the Information Technology Laboratory (ITL) Communications Group.

5. Select NCSA TCP/IP Ethernet Network to access the VAX8800, the TACOM Supercomputer, the WES Supercomputer, or other WES TCP/IP host computers. TCP/IP network addresses are assigned by the ITL Communications Group.

6. Select Asynchronous Network to attach to a serial network terminal server with PROCOMM, VISTACOM, DATAPASS, SMARTERM, or other communication programs. This will allow access to any of the 40 VAX computers within WES, the network modem pool for access to ONTYME, and other systems.

Further information for each network is summarized in the following pages. Additional information may be obtained by calling the ITL Customer Assistance Center at extension 4400, or by sending a Novell E-Mail message to username HAMPTON, on the Novell network system. Problem reports are actively encouraged.

Instructions for Use of the Novell Network

Purpose: The Novell Network allows for

a. Novell Electronic Mail

b. Virtual expansion of your existing hard disk drive

c. Use of Network LaserJet II printers

1. Reboot your PC from the Network menu. IPX.COM and NET3.COM will be automatically executed. These files are called from the autoexec.nov file. The NETWORK menu program swaps autoexec.bat and config.sys files when the Novell system is selected.

2. Change to F:
(If the config.sys file has a LASTDRIVE=X statement, then the Novell drive will not be F: but will be the next drive after the last defined drive in the config.sys)

3. SLIST will show all Novell servers on the station.

4. To login to a Novell server enter LOGIN serverid/yourname
example: F:>LOGIN LOGIN ITL01/FREE logs Don Free into the main ITL Novell server.
(Anyone can log into any Novell server at WES as GUEST)

5. To enter the mail system, type MAIL
   - To get HELP for Mail, type HELP
   - To read a memo enter READ msg#
   - To capture a memo enter PUT msg# to Filename
     (Memo will be saved as the specified filename in F:\USERS\YOURNAME\ and may be retrieved and printed with WordPerfect or Wordstar.)
   - To create a memo, enter EDIT Memoname, create memo, and press F2 to save.
   - To send a copy of the created memo to another user on the same Novell server, enter SEND MEMO memoname to otheruser. The command SEND EXPRESS MEMO memonameto otheruser will cause the recipient to be notified immediately of incoming mail if his PC is attached to the Novell network.
   - To print a document on the NOVELL network Laserjet II, login to the server, enter CAPTURE SERVER=ITLMSG NFF TI=3 to redefine LPT1 as the Novell server printer. (Your application must also be reconfigured to use a Laserjet II printer for this to work.) When finished, type ENDCAP to redefine LPT1 to your local printer. (This printer is located outside of Anna May Foster's office in ITL.)

6. To explore other features of the Novell network, type MENU MAIN immediately after you login.

7. To logout of the Novell server, type LOGOUT. It is not necessary to LOGOUT before switching to C:.

Instructions for the Use of DECnet-DOS Ethernet Network

1. Reboot your PC from the network menu selecting DECnet-DOS Ethernet Network.

2. Wait 60 sec after reboot for the PC to collect information about all DEC VAX computers and DECnet hosts on the network.

3. At the MS-DOS prompt, type:

   SETHOST WESIM3 (to connect to the VAX8800)
   SETHOST OUTDIAL (to connect to a 1200 8-N-1 modem)
   SETHOST HWDPS8 (to connect to the Honeywell DPS-08)
   SETHOST GL1 (to connect to Geotechnical Laboratory VAX 785)
   SETHOST PMAB (to connect to Coastal Engineering Research Center's PMAB VAX node)
   SETHOST HL1 (to connect to Hydraulic Laboratory VAX 750)
   etc.

4. A list of all available nodes can be obtain through DECNET by the following procedure.

   After the SETHOST command,

   a. Hit the F3 key
   b. Hit the Page Down key one time to select communications
   c. Move the cursor down to the first session not assigned.
   d. Press the key labeled END
   e. Press the cursor down key to scroll through the list of accessible VAX computers and DECNET nodes. This list should contain at least 50 reachable nodes.

5. The BAT files VAXUP.BAT and VAXDOWN.BAT have been included in the C:\DECNET directory to facilitate the copying of files from the PC to the VAX8800, and vice-versa.

   At the MS-DOS prompt, type VAXUP (filename) to send a file to the VAX8800.

   At the MS-DOS prompt, type VAXDOWN (filename) to download a file from the VAX8800.

6. VAXmail can be accessed after a login into the VAX VMS host by typing the command MAIL. Contact the ITL Customer Assistance Center at extension 4400 for help using the VAXmail system.

7. Mail can also be sent directly from the PC without logging into a VAX computer.

   From the C:\DECNET directory, type
   MAIL FILENAME NODE::USER to transmit a file.

   For example, the command
   MAIL ABCD WESIM3::RADHA sends the file ABCD
   to user Radha on the VAX8800 (wesim3).

Instructions for Using the NCSA TCP/IP Ethernet Network

1. Reboot your PC from the network menu selecting NCSA TCP/IP Ethernet Network

2. At the C:\NCSA prompt, type

TELNET LARRY	(to connect to the WES Supercomputer)
TELNET WESIM3	(to connect to the WES VAX8800)
TELNET DARRELL	(to connect to Access Processor #1)
TELNET DARRYL	(to connect to Access Processor #2)
TELNET 134.164.x.y	(to connect to any other TCP/IP host)

   TELNET is useful for terminal emulation, but does not support file transfers.

   The session will terminate when the user logs off the host computer.

3. For file transfers, at the C:\NCSA prompt, type

FTP LARRY	(to initiate a file transfer to, or from the WES Supercomputer)
FTP WESIM3	(to initiate a file transfer to, or from the VAX8800)

   etc. (FTP stands for file transfer protocol.)

   The user must then type his username and password for the host computer.

   The command FTP> GET filename will then download a file from the host computer to the PC.

   The command FTP> PUT filename will then upload a file from the PC to the host computer.

   Type FTP>HELP for a command summary.

   Type FTP>QUIT to terminate the FTP session.

4. The file C:\NCSA\CONFIG.TEL can be edited to delete or add features.

Instructions for Asynchronous Network Connections

1. Run Crosstalk, Procomm, Vistacom, Kermit, or any standard communication on the PC.

2. Invoke the network terminal server by hitting the carriage return button at least twice.

3. The terminal server logon banner will appear. If it asks for a username, type your last name.

4. The terminal server will now display the local prompt. (A local prompt similar to the MS-DOS prompt will appear.)

5. You can now issue the following commands to connect to the following services:

   a. CONNECT HWDPS8 (to connect to the Honeywell computer)

   b. CONNECT WESIM3 (to connect to the VAX8800)

   c. CONNECT OUTDIAL (to connect to out-dial 1200 8-N-1 baud modem)

   d. CONNECT ONTIME (to connect to out-dial 12007-E-1 baud modem

   e. SHOW SERVICES (to show all available services)

   f. HELP (for help on how to use the terminal server)
   (Password is PHONE for most modem services.)

6. A CTRL-I character sent to the terminal server will suspend the session. (The user has the option of changing the break to use a character other than CTRL-I.) RESUME to get back into the session.

7. Complete a session by typing DISCONNECT followed by LOGOUT at the server prompt.

8. The following simple sequence must be followed exactly for XMODEM file transfers to ONTYME.

   a. The PROCOMM translate table must be modified (PROCOMM.XLT) (Call X4400 for help installing PROCOMM.XLT)

   b. Type CONNECT ONTIME, dial ATDT9,6381551, and continue to log into ONTYME.

   c. As soon as the CONNECT 1200 message appears, hit the carriage return key several times.

   d. Type the letter a as your terminal identifier.

   e. Type CTRL-I to access the terminal server command state.

   f. Type SET SESSION PASSALL

   g. Type RESUME to return to the Ontyme session

   h. Type :READ XMODEM (filename) to initiate the file transfer

   i. After the transfer is complete, type +++ to alert the modem

j. Type ATZ to disconnect the modem and kill the session.

k. Type LOGOUT to log out of the terminal server.

APPENDIX C: INSTRUCTIONS FOR ACCESSING THE VAX 8800 SYSTEM AND THE US ARMY ENGINEER WATERWAYS EXPERIMENT STATION (WES) CRAY Y-MP 816128 SUPERCOMPUTER IN THE INFORMATION TECHNOLOGY LABORATORY (ITL)

VAX 8800

DECnet

1. The VAX 8800 may be accessed through the existing DECnet network at WES. However, the 8800 will not transparently pass you through to the WES CRAY; you must login to the 8800 and then initiate a TELNET (or FTP) session with the CRAY. Each laboratory VAX system manager should add the 8800's DECnet address and node name to their DECnet database. The 8800 is known as DECnet node "wesim3" with a DECnet address of 1.522. The following privileged NCP commands must be executed by your system manager and will put the 8800 in your system's DECnet database:

```
$ MCR NCP
NCP>SET NODE 1.522 NAME WESIM3
NCP>DEFINE NODE 1.522 NAME WESIM3
NCP>EXIT
$
```

Assuming that the DECnet link from your laboratory to ITL is up and running, you may now access the 8800 from your VAX by typing:

```
$ SET HOST WESIM3
```

Asynchronous terminal access

2. The 8800 may be accessed through ETHERNET terminal servers which are connected to the ITL INFOTRON data switch. Users may make either 1200/2400 baud dial-up connections to the switch or use local hard-wired connections (up to 19,200 baud). Access to the 8800 may be achieved as follows:

a. Set your terminal for the following characteristics:

VT100, VT200, or VT300 emulation
Full duplex (no local echo)
Proper/desired baud rate
1 stop bit
8 data bits and no parity
XON/XOFF flow control

b. For 1200/2400 baud dialup access, dial WES extension 3572 (outside of WES, dial (601) 634-3572). When a connection is made, slowly type carriage returns until the INFOTRON data switch prints an "A" on your screen. Type a capital "A" and the switch should then respond with a "C". Type a capital "C" and the switch should respond with a short banner and prompt you with "DESTINATION?". For local hard-wired users (at speeds up to and including 9600 baud) of the INFOTRON switch, establish a connection to the switch and proceed as above. If the hard-wired

connection is being made at 19200 baud, slowly type an "F" instead of a carriage return until the switch responds with an "A". Proceed as above after the switch responds with the "A" character on your terminal screen.

c. When you receive the "DESTINATION?" prompt from the switch, type in "ITLNET" and a carriage return. The INFOTRON will respond with a message similar to "CONNECTED TO 05-15". SLOWLY type in two (sometimes three or four) carriage returns. Your terminal screen should clear and the ETHERNET terminal server will print a short banner and prompt you for a command with "local>". You are now logged on to a terminal server but not to the 8800.

d. The ETHERNET terminal servers are configured to use the 8800 as a preferred service if you type just a "connect" command with no service name. You can now get a login prompt from the 8800 as follows:

local> connect	(assumes you want wesim3)
OR	
local> connect wesim3	(explicitly name the host you want)

You should now get a login prompt from the 8800 and you can login and proceed as you normally would on any VAX/VMS system.

e. When you log off of the 8800, you will be returned to the control of the terminal server and again receive the "local>" command prompt. You must log off of the terminal server (and the INFOTRON data switch) with the "logout" command. The server will log you out and the INFOTRON data switch will drop the connection to your terminal.

Supercomputer

Network configuration

3. The supercomputer center at WES contains a VAX 8800 system and twin SUN 4/280 systems. Both SUN systems are connected to the CRAY Y-MP 8/6128 supercomputer (running the UNICOS operating system) via high-speed FEI-3 point-to-point links. The VAX 8800 resides on the WES station-wide ETHERNET network. Each of the systems at WES has a name which is used for network identification purposes. The CRAY Y-MP is called LARRY, the two SUN's DARRYL and DARRELL, and the VAX 8800 system is called WESIM3. WESIM3 is the front-end which will be used by users for all communications to/from the CRAY Y-MP. The SUN gateways are totally transparent to users. Additionally, any computer system capable of utilizing TCP/IP protocols and attached to the WES ETHERNET network may communicate directly with the CRAY without using the VAX 8800.

Access methodology

4. All communications between WESIM3 and other WES VAX systems will utilize DECnet commands such as "SET HOST" (for interactive terminal sessions to SUPERI) and "COPY" (for file transfers). The Internet counterparts to "SET HOST" and "COPY" (TELNET for interactive usage and FTP for file transfers) must be used for communications between WESIM3 and the CRAY. Use lower case on all communications with the CRAY. UNIX is case-sensitive.

Examples of file transfers and interactive logins

5. Interactive logins to LARRY (using WESIM3). Log on to your VAX system. Issue the following DECnet command:

```
$ set host wesim3
```

If you don't have access to your own VAX, you may access WESIM3 through the INFOTRON data switch or EMULEX terminal servers in ITL. Either way, you'll get a login prompt from WESIM3 and you must login to WESIM3 and then access the CRAY with the following command:

```
$ telnet larry
```

After a few seconds, you should get the UNICOS login prompt from LARRY. Log on with your userid and password and you are now ready to use the CRAY.

6. File transfers to LARRY from WESIM3. Assuming that the file you wish to transfer to the CRAY is on your WESIM3 account and that you are logged in to WESIM3, follow the following steps:

Enter $ ftp larry

This initiates the file transfer protocol (FTP) program, which first will attempt a connection to LARRY. If the connection is made, you will be prompted for your LARRY userid (which will be echoed back to you) and then your password (which will not be echoed back to you). Assuming that you supplied a valid userid and password for LARRY, you will receive a "*" prompt from FTP indicating that it is awaiting your file transfer request(s). You may now send files to LARRY with the "put" command or retrieve them from LARRY with the "get" command. The following example retrieves a file named "fubar.dat" from LARRY and puts it on your WESIM3 account as "myfile.dat":

```
*get fubar.dat myfile.dat
```

If you want the file to have the same name on WESIM3 as it did on LARRY, just omit the last argument as follows:

```
*get fubar.dat
```

Now, suppose you want to send a file to LARRY from WESIM3. To send "fubar.dat" to LARRY with the name of "myfile.dat", try the following:

```
*put fubar.dat myfile.dat
```

If you want the file to have the same name on LARRY as it does on WESIM3, just omit the last argument:

```
*put fubar.dat
```

To terminate your FTP session, use the "quit" command which closes the communications session and returns you to the operating system command prompt.

7. The TELNET and FTP commands are thoroughly documented in the TCP/IP Network User's Guide (SG-2009) by Cray Research. However, any good reference book for the 4.3BSD version of UNIX will also have helpful information on these commands and UNIX networking.

8. File transfers from your VAX system to WESIM3. File transfers to/from your VAX system from/to WESIM3 will be made via DECnet with the COPY command. To transfer the file "abc.dat" from your account on your laboratory VAX system to your account on WESIM3, log on to your VAX system and issue the following command:

```
$ copy/log abc.dat wesim3"coe801 zagnut"::abc.dat
```

The example above assumes that your WESIM3 userid is "COE801" and the WESIM3 password is "zagnut". To copy the file "abc.dat" from your account on WESIM3 to your account on your laboratory VAX, log on to your VAX and issue the following command:

```
$ copy/log wesim3"coe801 zagnut"::abc.dat abc.dat
```

The "/log" qualifier is not required but will cause the COPY command to provide confirmation of the successfully completed file transfer to your terminal (or log file if issued in a batch job).